Analysis of factors affecting the final body weight in selected rabbit breeds

Analiza czynników wpływających na końcową masę ciała u wybranych ras królików

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Abstract

The objective of this research was to determine the effect of breed, feed type and sex, on the final body weight in New Zealand white and Blanc de Termonde rabbits. The experiment was conducted on a farm in the Małopolska Province in the south of Poland. Rabbits of both breeds were kept in identical conditions up to the age of 90 days. However, they were fed using two different methods – with commercial balanced (granulated) feed (9.75 MJ, 155 g protein) and farm-made feed (9.54 MJ, 157 g protein). Among New Zealand White rabbits, commercial balanced feed was given to 38 males and 42 females, whereas farm-made feed to 37 males and 38 females. Among Blanc de Termonde rabbits, commercial balanced feed was given to 65 males and 68 females, and farm-made feed to 54 males and 60 females. Daily gains were determined for both examined breeds divided into sexes. Then, we calculated interactions between breed and feed type, between breed and sex, as well as between feed type and sex. The mean body weights on the 90th day of fattening differed for both sexes and feed types. For both rabbit breeds, the higher mean final body weight was observed in case of feeding with the commercial balanced feed, whereas the highest body weight (2515.13 g) was registered for the females of Blanc de Termonde rabbits.

Keywords: breed, body weight, daily gains, feed, rabbits, sex

Streszczenie

Celem pracy było określenie wpływu rodzaju paszy, rasy i płci na końcową masę ciała u królików rasy białej nowozelandzkiej i białej termondzkiej. Doświadczenie przeprowadzono na fermie towarowej w południowej Polsce. Króliki obydwu ras były utrzymywane w jednakowych warunkach do 90 dnia życia. Żywiono je jednak na dwa różne sposoby, tzn. paszą pełnoporcjową granulowaną (9.75 MJ, 155 g protein)

i domową (9.54 MJ, 157 g protein). W przypadku królików białych nowozelandzkich paszą pełnoporcjową było skarmianych 38 samców i 42 samic, natomiast paszą domową 37 samców i 38 samic. Białe termondzkie paszą pełnoporcjową było karmionych 65 samców i 68 samic, a paszą domową 54 samce i 60 samic. Określono dzienne przyrosty dla obu badanych ras z uwzględnieniem płci. Obliczono interakcje między rasą a rodzajem paszy, między rasą a płcią oraz między rodzajem paszy a płcią. Uzyskane średnie masy ciała w 90 dniu tuczu były zróżnicowane dla obu płci jak i dla rodzaju stosowanej paszy. U obydwu rasy zaobserwowano większą średnią końcową masę ciała w przypadku karmienia paszą granulowaną pełnoporcjową niż domową, a najwyższą masę ciała zaobserwowano u samic (2515.13 g) rasy białej termondzkiej.

Słowa kluczowe: króliki, masa ciała, przyrosty dzienne, pasza, płeć, rasa

Detailed abstract

Współczesny konsument coraz częściej zainteresowany jest spożyciem mięsa białego, lekkostrawnego, o niskiej zawartości tłuszczu i cholesterolu. Takimi cechami prozdrowotnymi charakteryzuje się właśnie mięso królicze. Typowymi rasami nadającymi się do tuczu, których mięso charakteryzuje się wspomnianymi wysokimi walorami odżywczymi i dietetycznymi są: króliki białe nowozelandzkie i białe termondzkie. O stale rosnącej popularności mięsa króliczego świadczy coraz wyższy wskaźnik rocznego spożycia mięsa na jednego mieszkańca (np. Włochy 6 kg) w poszczególnych krajach Unii Europejskiej.
Doświadczenie przeprowadzono na fermie towarowej w południowej Polsce. Króliki obydwu ras były utrzymywane w jednakowych warunkach do 90 dnia życia. Żywiono je jednak na dwa różne sposoby, tzn. paszą pełnoporcjową (granulat) i domową. Pasza granulowana pełnoporcjowa oparta była na śrucie zbożowej, śrucie poekstrakcyjnej sojowej i suszu z lucerny (9.75 MJ, 155.00 g białka ogólnego, 32.00 g tłuszczu, 125.00 g włókna), natomiast podstawę w paszy domowej stanowiło zielonka z traw, marchew, siano łąkowe, chleb czerstwy, pszenżyto, a także śruta poekstrakcyjna rzepakowa (9.54 MJ, 157 g białka ogólnego, 27.25 g tłuszczu, 159.57 g włókna). W przypadku królików białych nowozelandzkich paszą pełnoporcjową było skarmianych 38 samców i 42 samice, natomiast paszą domową 37 samców i 38 samic. Z kolei jeśli chodzi o króliki białe termondzkie paszą pełnoporcjową było karmionych 65 samców i 68 samic, a paszą domową 54 samców i 60 samic. Określono dzienne przyrosty dla obu badanych ras z uwzględnieniem płci. Obliczono interakcje między rasą a rodzajem paszy, między rasą a płcią oraz między rodzajem paszy a płcią.
Uzyskane średnie masy ciała w 90 dniu tuczu były zróżnicowane dla obu płci jak i dla rodzaju stosowanej paszy. Najwyższą masę ciała przy żywieniu paszą granulowaną pełnoporcjową zaobserwowano u samic (2515.13 g) rasy białej termondzkiej, a najniższą u samców również tej rasy. Natomiast króliki żywione paszą domową najwyższą średnią masą ciała charakteryzowały się samice (2456.61 g) królików białych nowozelandzkich, a najmniejszą samce (2364.46 g) królików białych termondzkich. W okresie tuczu przyrosty dzienne dla obydwu obserwowanych ras wahały się od 25.72 g do 27.40 g. Przeprowadzona analiza wariancji wykazała wysoko istotny wpływ rodzaju paszy oraz płci na końcową masę ciała badanych

królików. Nie stwierdzono natomiast statystycznego wpływu rasy oraz interakcji między czynnikami głównymi (rodzaj paszy, rasa, płeć) na końcową masę ciała. Podsumowując, należy stwierdzić, że w analizowanym doświadczeniu rodzaj pasz był czynnikiem decydującym, który w sposób istotny wpłynął na końcową masę ciała w obu grupach badawczych.

Introduction

The preferred use of rabbits in Poland as well as in other countries worldwide is for obtaining healthy and nutritious meat (Kowalska, et al., 2012). The observed increase in the consumption of rabbit meat both in Poland (from 0.2 kg*person*year $^{-1}$ in 2005 to 0.9 kg*person*year $^{-1}$ in 2012) and worldwide, confirms its growing popularity (Kowalska and Kobylarz, 2013) and the need for healthy products (Dalle Zotte, 2001; Cavani and Petracci, 2004). Contemporary consumer is increasingly more interested in eating white meat, which is easily digestible and has low cholesterol content. At 34 mg to 40 mg of cholesterol in 100 g of meat, the cholesterol content in rabbit meat is very low compared to other popular types of meat from livestock (Forrester-Anderson et al., 2006). At the same time, it is characterised by a high content of protein (90% of which is assimilated by the human body), vitamins and microelements, as well as by a higher amount of essential amino acids as compared to other livestock (Szkucie and Libelt, 2006).

The typical rabbit breeds suitable for fattening which provide healthy and nutritious meat are New Zealand White and Blanc de Termonde. As proven by Piórkowska (2008), as well as Zając (1999), their daily live mass gain occurs at a high rate. For example, according to Kowalska (2011), New Zealand White rabbits achieve the weight of over 3 kg within 90 days of receiving pelleted commercial balanced feed.

Apart from the breed, other main factors which affect the fattening process and final weight are sex and feeding. Therefore, the objective of our research was to determine the influence of both sex and the type of feed on daily gains and the final weight in New Zealand White and Blanc de Termonde rabbits.

Materials and Methods

The research was conducted on New Zealand White and Blanc de Termonde rabbits from a farm in the south of Poland, all of which came from four subsequent litters. The period of investigations was from April to July 2013. The rabbits of both breeds (155 New Zealand White rabbits and 247 Blanc de Termonde rabbits, respectively) were kept in identical conditions up to the age of 90 days.

Depending on the type of feed, we divided the animals into two groups, additionally taking into account breed, sex and feeding type:

- Group I – fed with commercial balanced feed, containing e.g.: crushed cereal meal, extracted meal and dried alfalfa),
- Group II – fed with concentrate and forage, produced on the farm (containing triticale, carrots and hay).

The animals were fed *ad libitum*, having permanent access to drinking water. The delivered commercial balanced and farm-made feeds were almost equivalent taking into account energetic value and protein contents (Table 1). The investigations concerning the content of ingredients in commercial balanced and farm-made feeds

were carried out in the Laboratory of the Department of Animal Nutrition at the University of Science and Technology in Bydgoszcz.

In group I, among New Zealand White rabbits, there were 38 males and 42 females, whereas among Blanc de Termonde rabbits, there were 65 males and 68 females. In group I, the feeding scheme was as follows: 38 males and 42 females were fed with commercial balanced feed, while 38 males and 37 females were fed with farm-made feed, respectively.

Table 1. Nutritive value of 1 kg of delivered feeds (containing 90% of dry matter)
Tabela 1. Wartość pokarmowa 1 kg skarmianych pasz o zawartości 90% SM

Specification	Percen-tage (%)	Contents EM (MJ)	BO (g)	T (g)	W (g)
Commercial balanced feed	100.00	9.70	155.00	32.00	125.00
Farm-made feed*					
fresh grass	28.03	1.63	34.93	12.94	80.21
Carrot	5.32	0.63	4.21	0.97	3.88
meadow hay	19.40	2.02	31.18	3.12	49.47
stale bread	7.90	0.26	8.27	1.29	1.16
triticale	25.12	3.29	31.30	3.62	6.21
extracted meal (from rape)	14.23	1.71	47.84	5.31	18.64
Total	100.00	9.54	157.73	27.25	159.57

* - with addition of special ingredient “Polfamiks KF” (vitamins, mineral compounds, etc);
SM – dry matter; EM – metabolizable energy;
BO – total protein; T – crude fat; W – crude fiber.
Note: the above listed data is consistent with Polish Standards concerning animal nutrition (Normy żywienia…1994)

Group II included 38 males and 37 females of New Zealand White rabbits, as well as 54 males and 60 females of Blanc de Termonde rabbits. In group II, the feeding scheme was as follows: 65 males and 68 females were fed with commercial balanced feed, and 54 males and 60 females were fed with farm-made feed, respectively.
Kits were weighed within the first 24 hours after their birth, and then at slaughter, when they were 90 days old. To calculate mean daily gains, we subtracted their birth weight from the final weight, and divided the result by the number of days of the fattening process.
When calculating mean weight at the age of 90 days, we used the following linear model:

$$y_{ijkl} = \mu + R_i + S_j + P_k + (R\times S)_{ij} + (R\times P)_{ik} + (S\times P)_{jk} + e_{ijkl},$$

where:
μ – grand mean
y_{ijkl} – animal’s body weight
R_i – *i* effect – of the breed (New Zealand, Termonde)

S_j – *j* effect – of the sex (male, female)
P_k – *k* effect – of the feeding group (balanced, farm-made)
$(R\times S)_{ij}$, $(R\times P)_{ik}$, $(S\times P)_{jk}$ – interactions between factors
e_{ijkl} – random error.

Significance of the differences between the compared groups was determined with the Tukey's test. All calculations were made using a Polish version of the commercial 'Statistica' software.

Daily gains were determined for both sexes within both examined breeds. Furthermore, we calculated interactions between the breed and the type of feed, between the breed and the sex, as well as between the type of feed and sex.

Results and Discussion

The mean body weights obtained on the 90th day of fattening varied for both sexes as well as for the type of feed (Table 2). The highest body weight (2,515.13 g) was observed in females of the Blanc de Termonde breed, fed with commercial balanced feed; whereas the lowest (2,364.46 g) in males of the same breed, which were fed with farm-made feed. It was observed that in both breeds animals given commercial balanced feed had higher body weight on day 90 than those given farm-made feed. Significant differences were found between mean body weights of New Zealand rabbits, for both males and females, fed with different types of feed ($P \leq 0.05$); whereas in Blanc de Termonde rabbits, the differences between mean body weights for males and females receiving different feeds were highly significant ($P \leq 0.01$, Table 2).

We also found that for Blanc de Termonde rabbits fed with the commercial balanced feed, the mean body weights of females differed highly significantly when compared to males. Mean body weights of females which received farm-made feed differed only significantly when compared to males.
The observed coefficient of variation (Cv) for the mean body weight fluctuated between 2.50% and 7.83%. Females of both breeds were always characterised by a lower coefficient of variation compared to the males; it was also lower in rabbits fed with farm-made feed than in those fed with commercial balanced feed.

A very similar body weight on the 90th day in Blanc de Termonde rabbits was obtained by Niedźwiadek et al., (1983); whereas similar body weights in New Zealand rabbits at slaughter (day 90) were obtained by Maj et al., (2011). A slightly higher weight, close to 2.700 g, was obtained by Corino et al., (2002). The mean body weight at the age of 12 weeks was 2.532 g. New Zealand White rabbits are used to create highly productive crossbreds. As early as on day 84 of fattening, they can reach, when mated with Burgundy Fawn rabbits, the weight of 2.739 g, as was reported by Bieniek et al. (2012).
During the fattening period, daily gains for both of the analysed breeds were (Figure 1):
(a) New Zealand White – females – 27.34 g (commercial balanced) to 26.75 g (farm-made),
(b) New Zealand White – males – 27.19 g (commercial balanced) to 26.36 g (farm-made),
(c) Blanc de Termonde – females – 27.40 g (commercial balanced) to 26.57 g (farm-made),

(d) Blanc de Termonde – males – 26.92 g (commercial balanced) to 25.72 g (farm-made).

Table 2. Mean body weights in New Zealand White and Blanc de Termonde rabbits on the 90th day of fattening, depending on sex and feed type

Tabela 2. Średnie masy ciała królików nowozelandzkich i termondzkich białych w 90 dniu tuczu w zależności od płci i rodzaju paszy

Breed	Sex	Parameter	Feed type	
			commercial balanced	farm-made
			body weight (g)	
New Zealand White	males	n	38	37
		$\bar{x}$	2,496.24[a]	2,422.19[a]
		Cv	4.87	5.77
	females	n	42	38
		$\bar{x}$	2,509.90 [b]	2,456.61[b]
		Cv	2.50	5.03
Blanc de Termonde	males	n	65	54
		$\bar{x}$	2,471.72[AB]	2,364.46[cB]
		Cv	4.67	7.83
	females	n	68	60
		$\bar{x}$	2,515.13 [AC]	2,441.18[cC]
		Cv	2.72	5.72

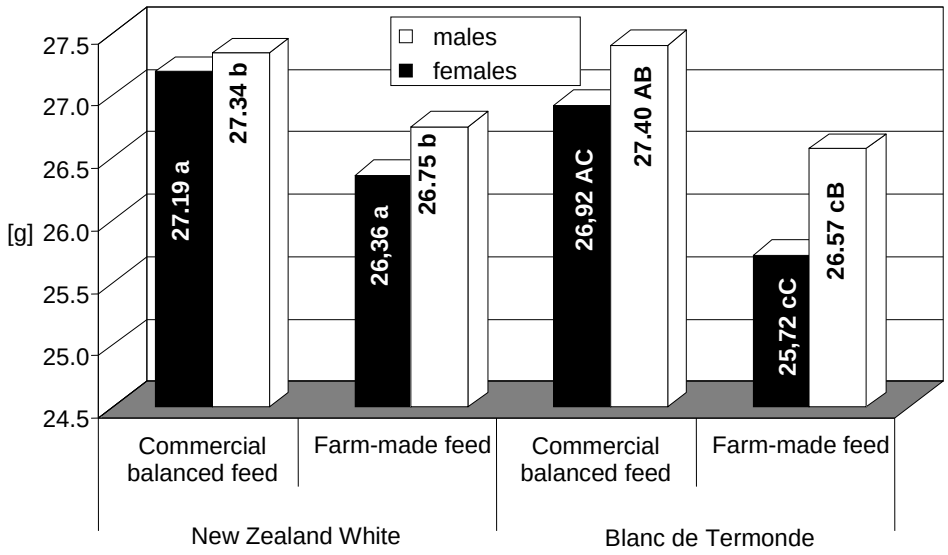
aa – this row indicates significance within males for P ≤ 0.05
bb – this row indicates significance within females for P ≤ 0.05
AA – this column indicates significance within sexes for P ≤ 0.01
cc – this column indicates significance within sexes for P ≤ 0.05
BB, CC – these rows indicate significance within feeds for P ≤ 0.01

Average daily gains in body weight for New Zealand White rabbits were higher for both males and females in case of feeding them with commercial balanced feed, compared to farm-made feed. Independently of the type of utilized feed, females gained faster than males. Taking into account New Zealand White rabbits, the highest weight (27.34 g) gains were observed for females fed with commercial balanced feed in comparison to females fed with farm-made feed (26.75 g). The differences of average body weight gains between males and females in case of both rabbit breeds were statistically significant (p≤0.05).

In case of Blanc de Termonde rabbits, higher daily weight gains were observed for animals fed with commercial balanced feed, as well. For females the gains were equal

Figure 1. Mean daily live weight gains (g) in males and females depending on breed and the type of feed

Wykres 1. Średnie dobowe przyrosty masy ciał (g) samców i samic w zależności od rasy oraz rodzaju podawanej paszy



aa – significance of differences between males getting different feeds for P ≤ 0.05
bb – significance of differences between females getting different feeds for P ≤ 0.05
AA – significance of differences between sexes within the same feed for P ≤ 0.01
cc – significance of differences between sexes within the same feed for P ≤ 0.05
BB –significance of differences between females getting different feeds for P ≤ 0.01
CC – significance of differences between males getting different feeds P ≤ 0.01

to 27.40 g and for males they were slightly lower (26.92 g). Females had higher daily weight gains in comparison to males, and the feed type had no influence on this observation. In general, within the whole feeding period the highest daily gains were observed for Blanc de Termonde females fed with commercial balanced feed.

The data presented in Figure 2 summarizes influence of the rabbit breed on daily weight gains taking into consideration the utilized feed. New Zealand White rabbits achieved higher daily weight gains for both types of feeding: commercial balanced (27.27 g) and farm-made feed (26.56 g), respectively. The highest disproportion of the daily weight gains (taking into account feeding type) was observed for Blanc de Termonde rabbits. Both differences in daily weight gains for the two breeds and two feeding types were evaluated as statistically highly significant (AA, BB, p≤0.01). The obtained results allow for preliminary recognition of the influence of breed and feeding type on daily weight gains in rabbits. However, these investigations have a pilot character, and thus further experiments should be considered aiming at obtaining more reliable results. Moreover, the number of investigated animals is comparable to those considered in the papers of Niedźwiadek et al. (1983) and Maj et al. (2011). It seems that in the planned repeated experiments, the number of rabbits will remain similar, though some other traits may also be studied.

Very similar daily gains of 26 g to 27 g in New Zealand rabbits are reported by Fijał and Gacek (2000).

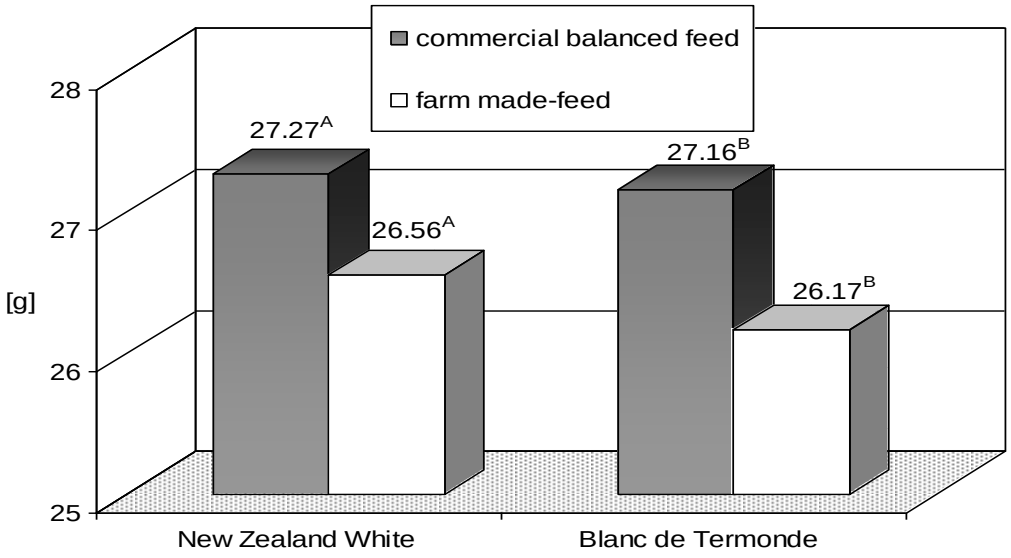


Figure 2. The effect of breed on the daily body weight gain, taking into account the type of feed

Wykres 2. Wpływ rasy na przyrosty dobowe masy ciała królików z uwzględnieniem rodzaju paszy

A slightly wider range of daily gains in pure breeds, including both New Zealand White as well as Blanc de Termonde, of 22 g to 34 g was obtained in the research of Zając (2001). However, Piórkowska and Niedźwiadek (1996) obtained daily gains in New Zealand rabbits from 21 g to 27 g; though, the lower of the two values occurred in rabbits which had limited access to water in the course of the entire fattening period.

Table 3. Value of F_{emp} and significance of the effect of breed, sex and feed type on the final (g) body weight of the examined rabbits

Tabela 3. Wartość F_{emp} oraz istotność wpływu rasy, płci i rodzaju paszy na końcową (g) masę ciała badanych królików

Factor	Value	
	F_{emp}	P (significance level)
breed	3.28	0.0710
feed type	36.49	0.0001
Sex	10.82	0.0011
breed x feed type	1.10	0.2960
breed x sex	1.96	0.1624
feed type x sex	1.31	0.2536

up to day 90. Gains of approximately 32 g, for both males and females (31.9 and 31.8, respectively) were obtained in the research on Blanc de Termonde rabbits conducted by Niedźwiadek et al. (1983).

Maj et al. (2009) obtained daily gains of 23 g to 25 g by crossbreeding New Zealand White and Californian rabbits. For hybrid line rabbits, bred mainly in the European Union
(especially in France, Belgium and Italy), daily gains are significantly higher (Colin, 1993; Lebas et al., 1991, Masoero et al., 1996) than the authors' research results.

Having conducted the analysis of variance, we found that there was a highly significant effect of the type of feed and sex on the final body weight in the examined rabbits (Table 3). At the same time, we did not observe any statistical influence of breed or interaction between main factors (breed, sex, type of feed) on the above trait. A slightly different effect of the interaction between age and sex was studied by Maj et al. (2011), which also had no significant influence on the slaughter performance of New Zealand rabbits.
In conclusion, it should be said that the feed type and sex of animals had a significant effect on the final body weight of the examined rabbit breeds.

Conclusions

The performed investigations described in the present paper confirm higher usefulness of the commercial balanced feed in feeding two breeds of rabbits compared to the farm-made feed. Higher daily weight gains were observed for females of both considered rabbit breeds: New Zealand White and Blanc de Termonde. We found a statistically significant effect of the type of feed and sex on the final body weight; however, no significant effect was observed of the interactions between the main factors on the examined traits.

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