

ANALYSIS OF CONFORMATION BREEDING VALUE OF BLANC DE TERMONDE AND POPIELNO WHITE RABBITS ON A REPRODUCTIVE FARM

Dorota Kołodziejczyk, Dorota Elżbieta Weremczuk, Aleksandra Paskudska, Magda Socik, Stanisław Socha✉

Department of Breeding Methods and Poultry Breeding, University of Natural Sciences and Humanities, B. Prusa 12/14, 08-110 Siedlce, Poland

ABSTRACT

The aim of the study was to analyze the breeding value of selected conformation traits of rabbits of two breeds (Blanc de Termonde and Popielno White), reared on a reproductive farm located in south-eastern Poland. A total of 981 animals were subjected to the study over three consecutive years. The traits that were analyzed included: body weight, body structure (the size of the body expressed in points), type, coat quality, color, specific traits of the breed. Performed ANOVA involved the effects of the breed, calendar year and sex, and showed statistically significant ($P \leq 0.01$) effect of the breed on body structure, body weight expressed in points, type and the total score attained by rabbits. The year of license ($P \leq 0.01$) statistically significantly affected the body weight expressed in points, the quality of the coat and the type. Correlations were considerably varied. Those between the total score and other analyzed traits were positive, in the range 0.077–0.444, while negative correlations, –0.076 to –0.052, were found between body weight in grams and the quality of the coat as well as between the body weight at points, type and quality of the coat. It should be emphasized that the rabbits subjected to observation and analysis were characterized by good breeding value.

Key words: rabbits, conformation traits, reproduction farm, breed, breeding value

INTRODUCTION

The domestication of rabbits was started by medieval monks, who kept them for fur in some kind of rabbit pens, or hunting gardens populated with both domesticated and non-domesticated rabbits [Chwastowska-Siwiecka et al., 2011]. The monks were first to perform genetic selection aimed at obtaining larger individuals. As a result, the emergence of various breeds and types of rabbits has begun [Barabasz and Bieniek, 2003]. Domestication of rabbits led to changes in the anatomical structure of the body, in terms of their size, proportions of individual body parts, color and quality of the coat, as well as metabolism rate. About 120 breeds and variants of rabbits for meat, fur and laboratory purposes have been developed up to the present time [Kołodziejczyk et al. 2016].

The Blanc de Termonde and Popielno White rabbits belong to medium breeds of high slaughter efficiency and

good composition of the carcass. Their body structure is compact, with an elongated trunk with well developed middle and posterior parts. Blanc de Termonde rabbits were brought to Poland in 1978. The breed was obtained through the selection of White Giant rabbits. These animals are characterized by good slaughter performance parameters. At age three months, Blanc de Termonde rabbits are able to attain as much as 2.6 kg, with slaughter efficiency of around 60%. This breed is ideal for the purebred breeding production, but also represents an excellent material for crossbreeding [Warrlich 2012].

By contrast, Popielno White rabbits are a native breed of rabbits. Their name derives from the Experimental Station of the Polish Academy of Sciences in Popielno, where research work on the breed was conducted. The selection was begun in 1950. In 1989, the Popielno White rabbit breed was evaluated for slaughter and genetic value. The genetic resources of the breed has been subject

✉socha@uph.edu.pl

to protection since 1999. Rabbits of this breed are characterized by high fertility, with litters reaching up to 14 kits, and also feature high rates of weaning. Research conducted by Topczewska et al. [2013] on rabbits of the following breeds: Alaska, New Zealand White, Blanc de Termonde, California, Chinchilla Giganta, and Popielno White confirm the high fertility of the latter rabbits. Of the above-mentioned breeds, Popielno White rabbits were characterized by the highest values of reproductive indicators. The authors also showed a strong correlation between the number of live-born rabbits and the body weight of the litter. Young Popielno White rabbits, aged 90 days, can reach a body weight of about 3 kg, with a slaughter efficiency of around 60% [Bielański and Kowalska 2011, Bielański and Pankowski 2017].

According to Bielański et al. [2011], Popielno White rabbits can be kept as domestic pets, but also farmed commercially for meat, since the carcass quality of this rabbit does not differ significantly from that of the New Zealand White, a popular meat breed.

All domesticated livestock animals undergo systematic breeding work, enabling permanent improvement of their functional characteristics. In the process of breeding and selection, the following stages are distinguished: evaluation of the use and breeding value of animals, selection of individuals for reproduction and mating in order to obtain offspring with the most desirable traits [Kołodziejczyk et al. 2016].

The performance evaluation of animals is carried out by measuring the phenotype traits that are being improved. The results are then used to assess the breeding value of animals, recognition of herds as breeding stocks and as a criterion for selection and culling.

The aim of the study was to analyze the breeding value of selected conformation traits of the Blanc de Termonde and Popielno White rabbits on a reproductive farm.

MATERIAL AND METHODS

Animals that were evaluated came from a breeding rabbit farm located in south-eastern Poland. The farm specializes in managing various breeds, such as New Zealand White, Blanc de Termonde, Alaska, Californian White, Chinchilla Great and Popielno White. The animals are kept in a cage system. The cages are single- or two-storied and made of galvanized steel mesh. The cages satisfy all the animal welfare requirements and legal regulations regarding the living conditions of rabbits [Anonymous 2017].

The animals were fed pelleted feed in accordance with the current feeding standards for rabbits [Gugolek, 2011].

The study was carried out on 981 animals of two breeds of rabbits (Blanc de Termonde and Popielno White) over the period of three consecutive years. The following characteristics were evaluated: body weight in grams, body weight in points, body structure, type, quality of coat, coat color, specific breed traits and total score for all traits in accordance with the standard of assessment of the breed [Anonymous 2000]. The age of the animals was in line with the rabbit phenotype assessed standard, i.e. a minimum of 5 months [Anonymous 2016]. For the most part, the rabbits were within the age range from 6 to 8 months.

According to the standard, rabbits can score a maximum of 100 points during the license assessment for the following traits [Anonymous 2016]:

- Body weight: 10 points,
- Conformation: 20 points,
- Breed type: 20 points,
- Coat quality: 20 points,
- Coat color: 10 points,
- Specific breed traits: 20 points.

A multivariate analysis of variance (MANOVA) was carried out for each of the studied traits. The effect of the factors on the dependent variable was estimated this way. The model included the effects of sex, evaluation year and breed on each conformation trait:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl}$$

where:

- Y_{ijkl} – trait level,
- μ – population mean,
- a_i – effect of sex,
- b_j – effect of evaluation year,
- c_k – effect of breed,
- e_{ijkl} – error.

Computations were carried out using the SAS [2000] package. The statistics included means, standards deviations and significance of differences within each source of variability.

RESULTS AND DISCUSSION

Body weight was one of the evaluated traits. A significant ($P \leq 0.01$) effect of breed on the body weight in grams was found (Table 1).

A larger mean body weight was attained by Blanc de Termonde rabbits, 4392 g, compared to Popielno White rabbits, 4044 g. Also in the studies of Kmiecik et al. [2016], Blanc de Termonde rabbits were characterized by a significantly higher body weight (at 7, 35, 42, 63 and 84 days of rearing) compared to Californian and

Table 1. Average body weight of rabbits depending on: sex, evaluation year and breed of animals

Tabela 1. Średnie masy ciała królików w zależności od: płci, roku oceny i rasy zwierząt

Source of variability Źródło zmienności		n	Mean Średnia	SD
Sex Płeć	Males – Samce	116	4246	519.35
	Females – Samice	865	4191	543.22
Evaluation year Rok oceny	2012	241	4221	655.90
	2013	476	4244	678.52
	2014	264	4189	703.38
Breed Rasa	Popielno White – Popielniański biały	534	4044A	697.64
	Blanc de Termonde – Termondzki biały	447	4392B	683.32

A, B – means marked with different letters differ significantly at $P \leq 0.01$.

A, B – średnie oznaczone różnymi literami różnią się istotnie przy $P \leq 0.01$.

Table 2. Mean body weight score in relation to sex, year of evaluation and breed

Tabela 2. Średnia ocen dla masy ciała wyrażonej w punktach, w zależności od: płci, roku licencji i rasy

Source of variability Źródło zmienności		n	Mean Średnia	SD
Sex Płeć	Males – Samce	116	9.12	0.75
	Females – Samice	865	9.29	0.88
Evaluation year Rok oceny	2012	241	9.48A	0.93
	2013	476	9.17B	1.09
	2014	264	8.97C	1.14
Breed Rasa	Popielno White – Popielniański biały	534	8.96A	1.16
	Blanc de Termonde – Termondzki biały	447	9.46B	1.06

A, B, C – means marked with different letters within each source of variability differ significantly at $P \leq 0.01$.

A, B, C – średnie oznaczone różnymi literami w obrębie poszczególnych źródeł zmienności różnią się istotnie przy $P \leq 0.01$.

Table 3. Average score for body structure in relation to sex, evaluation year and breed

Tabela 3. Średnia ocen dla budowy ciała w zależności od: płci, roku licencji i rasy

Source of variability Źródło zmienności		n	Mean Średnia	SD
Sex Płeć	Males – Samce	116	18.09	0.54
	Females – Samice	865	18.03	0.59
Evaluation year Rok oceny	2012	241	18.10	0.62
	2013	476	18.11	0.65
	2014	264	17.96	0.65
Breed Rasa	Popielno White – Popielniański biały	534	18.11	0.69
	Blanc de Termonde – Termondzki biały	447	18.01	0.63

Table 4. Average score for breed type in relation to sex, evaluation year and breed

Tabela 4. Średnia ocen dla typu rasowego w zależności od: płci, roku licencji i rasy

Source of variability Źródło zmienności		n	Mean Średnia	SD
Sex Płeć	Males – Samce	116	17.89	0.43
	Females – Samice	865	17.92	0.59
Evaluation year Rok oceny	2012	241	17.82A	0.62
	2013	476	17.82A	0.65
	2014	264	18.08B	0.65
Breed Rasa	Popielno White – Popielniański biały	534	17.81A	0.69
	Blanc de Termonde – Termondzki biały	447	18.00B	0.63

A, B, C – means marked with different letters differ significantly at $P \leq 0.01$.

A, B, C – średnie oznaczone różnymi literami różnią się istotnie przy $P \leq 0.01$.

Popielno White rabbits. Zawiślak et al. [2015] confirm that Blanc de Termonde is a breed of excellent slaughter performance. The authors investigated the influence of the Blanc de Termonde and New Zealand White breed on the final body weight of rabbits. The highest body mass (2515.13 g) on the 90th day of life was achieved by Blanc de Termonde females.

As had been found by Kmiecik et al. [2016], the sex factor was of little effect on the variable. Despite the fact that there was no significant effect of sex and the year of assessment on the body weight, it should be stated that males exhibited a slightly higher average body weight and the best results were obtained in the second year of the study, 2013 (Table 1).

The value of body weight expressed in grams does not translate to a score attained by the trait of body weight. The standard of rabbit conformation evaluation [Anonymous 2016] established body weight ranges for each breed for the age 8 months and older. A certain score is assigned for attaining body weight of a given range. An animal may obtain maximum 10 points for this trait.

We found that the year of evaluation and the breed had a significant effect ($P \leq 0.01$) on the body weight expressed in points (Table 2).

The highest average number of points for body weight was found in animals in the first year of the study, 2012 (9.48), followed by a downward trend in two subsequent years. However, when analyzing the average scores in relation to breed, better results (by 0.5 points) were obtained by the Blanc de Termonde rabbits.

Although there was no significant effect of the sex of rabbits on the body weight expressed in points, it can be noticed that females were characterized by better parameters of this trait. Their average grade for body mass expressed in points was 9.29. This indicates that more females than males received higher scores in the assessment of this trait. This seems to be confirmed by studies conducted much earlier by Ristić [1988] or Staliński et al. [1989]. These authors prove that rabbit growth rate depends on sex.

Another analyzed trait was the body conformation of the rabbits. In its assessment, harmony in the animal body structure is the trait focused upon. The maximum score an animal can get for this feature is 20 points [Anonymous 2016].

It has been demonstrated that none of the analyzed sources of variability had a statistically significant effect on the rabbit body structure (Table 3).

It was found that there are some differences in body structure of rabbits of the tested breeds. Slightly higher average assessments of body structure were characterized by the Popielno White breed. The average values of this characteristic for both breeds oscillated at the level of 18 points. The results obtained are similar to those presen-

ted by Otulakowski [2011]. The rabbits assessed by this author belonged to different medium meat breeds and, in terms of body conformation, all achieved a low grade, remaining in the range of 16–18 points. Rabbits with a model score for this feature were very rare.

There were slight between-sex differences in the average body conformation grades in favor of males. In terms of the study year, the highest average for body conformation grades occurred in 2013, while the lowest in the last year of the assessment. The score for breed type was significantly influenced by the breed and year of evaluation (Table 4).

Higher average grades for breed type were obtained Blanc de Termonde rabbits, whereas for the evaluation year, by far the best results were recorded in 2014. It may be a result of properly conducted breeding work.

The quality of coat is evaluated in the range 0–20 points. The quality of the coat consists of: hair density, cover hair length, elasticity and silkiness of the cover. Table 5 shows that the quality of the coat was significantly affected ($P \leq 0.01$) only in the year of the evaluation.

The highest average scores were obtained in the first year, whereas the second year of studies proved to be the least favorable. The results are similar to those obtained by Kołodziejczyk et al. [2013] in their studies conducted on rabbits of other breeds from the same group of medium-sized meat rabbits.

Although the influence of sex on the assessed trait was not statistically significant, it can be seen that males were characterized by higher scores.

Higher average scores of the fur coat quality were attained by the Blanc de Termonde rabbits.

Another trait taken into account was the color of the coat, which depends mainly on the color of guard hair and its shades in different parts of the body. For this trait, animals can get a maximum of 10 points.

The analysis of variance for the color of the coat revealed that none of the considered sources of variability (Table 6) had a statistically significant effect.

Analyzing the means in relation to the sex of rabbits, females scored higher (Table 6). If we look at the breed, the Blanc de Termonde was better (Table 6). The results are similar to those carried out by Otulakowski [2011], who claimed that Blanc de Termonde was the breed with the highest percentage of individuals achieving the champion's score for the coat color.

Another evaluated traits involved specific breed traits (including color of the down, eyes and claws). This trait can score a maximum of 20 points [Anonymous 2000]. All the evaluated animals scored 20 points, hence the trait did not require any detailed statistical analysis.

As far as the total score is concerned, Blanc de Termonde achieved better results than the Popielno White

Table 5. Average score for coat quality in relation to sex, evaluation year and breed

Tabela 5. Średnia ocen jakości okrywy włosowej w zależności od: płci, roku licencji i rasy królików

Source of variability Źródło zmienności		n	Mean Średnia	SD
Sex Płeć	Males – Samce	116	18.24	0.43
	Females – Samice	865	18.13	0.59
Evaluation year Rok oceny	2012	241	18.33A	0.62
	2013	476	18.08B	0.65
	2014	264	18.15B	0.65
Breed Rasa	Popielno White – Popielniański biały	534	17.80	0.69
	Blanc de Termonde – Termondzki biały	447	18.00	0.63

A, B – means marked with different letters differ significantly at $P \leq 0.01$.

A, B – średnie oznaczone różnymi literami różnią się istotnie przy $P \leq 0.01$.

Table 6. Average score for coat color in relation to sex, evaluation year and breed

Tabela 6. Średnia ocen barwy okrywy włosowej w zależności od: płci, roku licencji i rasy królików

Source of variability Źródło zmienności		n	Mean Średnia	SD
Sex Płeć	Males – Samce	116	9.55	4.20
	Females – Samice	865	9.95	4.41
Evaluation year Rok oceny	2012	241	9.38	5.28
	2013	476	9.95	5.45
	2014	264	9.93	5.69
Breed Rasa	Popielno White – Popielniański biały	534	9.63	5.55
	Blanc de Termonde – Termondzki biały	447	9.88	5.50

Table 7. Average total score in relation to sex, evaluation year and breed

Tabela 7. Średnia ocen sumy wszystkich cech w zależności od: płci, roku licencji i rasy

Source of variability Źródło zmienności		n	Mean Średnia	SD
Sex Płeć	Males – Samce	116	92.89	1.29
	Females – Samice	865	93.22	1.47
Evaluation year Rok oceny	2012	241	93.35	1.55
	2013	476	92.90	1.75
	2014	264	92.90	1.62
Breed Rasa	Popielno White – Popielniański biały	534	92.79A	1.62
	Blanc de Termonde – Termondzki biały	447	93.31B	1.69

A, B – means marked with different letters differ significantly at $P \leq 0.01$.

A, B – średnie oznaczone różnymi literami różnią się istotnie przy $P \leq 0.01$.

rabbits. As can be seen in Table 7, the differences between the breeds were significant in this respect.

The highest total score was achieved by the rabbits evaluated in the first year of the study. In the following two years, the scores were lower and remained at a similar level. In order to improve the total scores (overall assessment), the selection for the desired traits should be intensified.

Table 8 presents the general statistical characteristics of the analyzed traits. It shows that the rabbit breeds tested were characterized by the general average of the

analyzed traits at the level of 93.12 points, which corresponds to the grade “good” [Anonymous 2016]. The obtained results correspond with the results of Kowalska [2016] and Zawiślak et al. [2016]. In the research of the former author on Popielno White rabbits, animals attained an average assessment of the conformation at the level of 93.6–93.9 points, which correspond to grades “good” and “very good”. Zawiślak et al. [2016] showed that most rabbits received “good” and “very good” (93–95 points); their percentage reached 70.1%.

Table 8. Statistical characteristics of material

Tabela 8. Charakterystyka statystyczna badanego materiału

Zmienna	N	Mean Średnia	SD	Minimum	Maksimum
Body weight, g – Masa ciała, g	981	4188	551.77	4000.0	5700.0
Body weight, points – Masa ciała, punkty	981	9.24	0.84	7.0	10.0
Body structure – Budowa ciała	981	18.05	0.51	17.0	19.0
Breed type – Typ rasowy	981	17.89	0.50	17.0	19.0
Coat quality – Jakość okrywy włosowej	981	18.12	0.46	17.0	20.0
Coat color – Barwa okrywy włosowej	981	9.95	4.17	8.0	10.0
Specific breed traits – Specyficzne cechy rasowe	981	20.00	0.00	20.0	20.0
Total score – Suma punktów	981	93.12	1.31	89.0	96.0

Table 9. Phenotypic correlations (above the diagonal) and their level of significance (below the diagonal) between the traits of rabbits

Tabela 9. Korelacje fenotypowe (nad przekątną) i ich poziom istotności (pod przekątną) pomiędzy cechami pokroju królików

Trait – Cecha	Body weight, g Masa ciała, g	Body weight, pts Masa ciała, pkt	Body structure Budowa ciała	Breed type Typ rasowy	Coat quality Jakość okrywy włosowej	Coat color Barwa okrywy włosowej	Total score Suma punktów
Body weight, g Masa ciała, g	–	0.733	0.009	0.004	–0.076	0.047	0.444
Body weight, pts Masa ciała, pkt	<.0001**	–	0.067	–0.052	–0.060	0.028	0.620
Body structure Budowa ciała	0.790	0.037*	–	0.051	0.184	0.003	0.536
Breed type Typ rasowy	0.900	0.103	0.110	–	0.017	0.009	0.382
Coat quality Jakość okrywy włosowej	0.017*	0.062	<.0001**	0.600	–	0.063	0.390
Coat color Barwa okrywy włosowej	0.139	0.385	0.914	0.773	0.047	–	0.077
Total score Suma punktów	<.0001**	<.0001**	<.0001**	<.0001**	<.0001**	0.017*	–

*. ** – Significance at * $P \leq 0.05$. ** $P \leq 0.01$.

*. ** – Istotność na poziomie * $P \leq 0.05$. ** $P \leq 0.01$.

Table 9 shows phenotypic correlations of the conformation traits of the analyzed rabbit breeds. The calculated phenotypic correlations between the total score achieved and other traits were at the level from 0.077 to 0.62 and proved to be statistically significant. A negative and very low correlation was found in the relationship between body weight (in g) and the quality of the coat. On the basis of the obtained results, it can be stated that conducting selection towards body weight improvement may deteriorate the quality of coat. Low and negative correlations also occurred between the body weight expressed in points and the quality of coat (Table 9), which confirms that selection for weight may affect the coat quality. In

addition, the breed type may deteriorate, too. However, improving the quality of the coat may adversely affect the body weight of rabbits.

CONCLUSIONS

The results indicate that both Blanc de Termonde and Popielno White rabbits were characterized by good parameters of the analyzed traits.

Bucks had greater body weight, better body structure and better quality of hair coat compared to does. On the other hand, females attained a higher score for the color and higher overall grades. However, the impact of

sex on the examined characteristics was statistically non-significant.

The breed had a significant effect ($P < 0.01$) on body weight expressed in grams and body weight expressed in points, as well as the type and overall grade. Higher parameters of all the analyzed traits, except for the conformation, were achieved by the Blanc de Termonde rabbits.

Over the period under analysis, the third year of research was the least favorable, in which animals achieved higher mean values only for the type.

The phenotypic correlations observed between the total score and other traits are positive and relatively high. However, the negative phenotypic correlations occurred between body weight (in g) and the quality of the coat. Similarly, an unfavorable relationship was found between body weight expressed in points and the type. It is worth noting that the correlation between the breed type and body weight expressed in points is negative, while the correlation between the type and body weight expressed in grams is positive. The point score is a discrete variable (expressed as integer), whereas body weight in grams is a continuous trait, which is why correlations can be varied.

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ANALIZA WARTOŚCI HODOWLANEJ CECH POKROJU KRÓLIKÓW RASY TERMONDZKI BIAŁY I POPIELNIAŃSKI BIAŁY Z FERMY REPRODUKCYJNEJ

STRESZCZENIE

Celem pracy była analiza wartości hodowlanej wybranych cech pokroju królików dwóch ras (termondzki biały i popielniański biały), pochodzących z fermy reprodukcyjnej zlokalizowanej w południowo-wschodniej Polsce. Badaniom poddano 981 zwierząt w okresie trzech kolejnych lat. Cechami, które przeanalizowano były: masa ciała, budowa ciała (wielkość zwierząt wyrażona w punktach), typ rasowy, jakość okrywy włosowej, barwa okrywy włosowej, specyficzne cechy rasowe. Wykonane analizy wariancji uwzględniające wpływ rasy, roku kalendarzowego i płci wykazały statystycznie istotny ($P \leq 0,01$) wpływ rasy na budowę ciała, masę ciała wyrażoną w punktach, typ rasowy oraz łączną sumę punktów, jaką uzyskały króliki. Rok licencji statystycznie istotnie ($P \leq 0,01$) wpłynął na masę ciała wyrażoną w punktach, jakość okrywy włosowej oraz typ rasowy. Oszacowane w pracy wartości korelacji były dość zróżnicowane. Między łączną sumą punktów za wszystkie cechy a pozostałymi analizowanymi cechami były dodatnie na poziomie 0,077–0,444, natomiast wartości ujemne w granicach –0,076 do –0,052 uzyskano między masą ciała w gramach a jakością okrywy włosowej oraz między masą ciała w punktach a typem i jakością okrywy włosowej. Należy podkreślić, że króliki poddane obserwacji i analizie charakteryzowały się dobrą wartością hodowlaną.

Słowa kluczowe: króliki, cechy pokroju, ferma reprodukcyjna, rasa, wartość hodowlana