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ANALYSIS OF CHANGEABILITY OF FEATURES IN CHINCHILLAS (*CHINCHILLA VELLIGERA M.*)

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ABSTRACT

The aim of this research is to analyse the changeability of features in chinchillas (*Chinchilla veligera M.*) according to the animals' country of origin, sex and the year of evaluation. The research was based on the data taken from the breeding farm within the four-year period (1995-1998). In 1998 there were about 60 females of the basic herd. The breeding was conducted in polygamous system (1 male and 4 females).

The variance analysis showed a significant influence of the animals' year of birth on all the features (their size, colour, purity of colour, fur structure, belly belt, and total evaluation). Sex had a significant influence on the fur structure and the total evaluation. The country of the animal's origin (genetic group), however, did not influence

the individual habit features but the total evaluation only. The results obtained show significant influence of environmental factors on the analysed features.

The arithmetical averages of the individual features were characterised by variations between the individual years not only in the group of females but in the group of males as well. During the whole observation period the higher averages were noticed in the group of the native animals which in the total evaluation ranged from 27,3-28,3. In the group of half imports the average ranged from 26,8 to 28,3 and in the group of imported animals it was 26,7-27,4. The lower values of the features observed in the group of imported animals may prove insufficient animals' adaptation to our breeding conditions or different methods of selection in Poland and in the chinchillas' country of origin.

The phenotypic variation of traits most probably originates from environmental influences, which is proved by low values of heritability (depending on the feature they varied from 0,167 to 0,223). In order to increase the genetic differentiation of animals introduction of new chinchillas from out of the farm should be continued.

Key words: chinchilla, changeability, hereditability

INTRODUCTION

Chinchillas have the most delicate and the thickest fir of all fur animals. The worth of these animals has its basis in quite strong and durable skin and beautiful fur constituted of down hair - 21mm to 28mm long and longer leading hair. The fur grows in tufts. In one tuft there grows one leading hair and about 40-70 down hairs and in one cm^2 there are about 20 000 hairs. The number of hairs in a tuft and the number of tufts in one cm^2 of skin decides about the thickness of whole fur.

From the breeding and skin production points of view, the most valuable breeds are standard and black velvet and their crossbreeds. Many features are taken into consideration when evaluating chinchilla skins, but only their sum decides about the look of the skin, beauty of fur and its durability in use. The most important of them are: thickness of fur, its equality of length, resilience and fluffiness of hair, its softness and colour, gloss, heat-absorbency and durability.

Progress in production, visible through improved use features in consecutive generations, may be arrived at through improvement of environment conditions in which the animals are kept on the one hand and, through such breeding procedures which transform the genetic structures of the herds to satisfy the breeder's needs on the other. It is only the latter method that guarantees long term effect of changes in a herd. The extent of progress in breeding (genetics) depends on the accuracy of the assessment of quality, intensity of selection and genetic changeability.

An extremely important factor in breeding fur animals, including chinchillas, is an objective assessment of the fur structure, which influences the accuracy of the assessment of quality and intensity of selection. High subjectivity of the assessment of fur structure quality and size of the animals applied when assessing fur animals may substantially reduce the effectiveness of selection (9, 10, 12).

The final result of breeding chinchillas is the chinchilla skin and the breeder should comply with well-defined selection criteria that let him produce skins as demanded by the market. Skins produced in Poland, however, are of lower quality than those imported ones. In order to improve the quality in a relatively short period of time, it is necessary to intensify production. One of the options is to import chinchillas, to cross them with Polish breeds and to skilfully manage selection processes.

The objective of this research is to analyse the changeability of the following features: size of the animals and quality of fur of chinchillas (*Chinchilla velligera M.*) in relation to the origin of animals, their sex and the year of evaluation at a reproduction farm.

MATERIALS AND METHODS

The data for research was delivered by a reproduction farm of standard chinchilla in Białystok. The farm was founded in 1981 and in 1998 there were ca. 60 females of a basic herd. Breeding was conducted in a polygamous system (1 male and 4 females).

The animals were fed hay and feed appropriate for chinchillas, in a form of granulate. A daily dose of granulate per a chinchilla was ca. 20 g. Besides, the animals were administered hay (70-80 g. daily) and the amount of water was not limited. Features of animals born in the farm were analysed once a year. 5 features were analysed, and when 0 points were given to even one of the features, the animal was disqualified and was not further evaluated. The maximum number of points an animal could obtain was 30.

There were 3 genetic groups of chinchillas in the farm:

- animals referred to as native (from parents born in Poland),
- animals referred to as half-imports (one of the parents was imported or was a child of imported parents),
- animals referred to as imports (parents were imported).

Data from a four-year license, 1995-1998, was used for the analysis. Ca. 700 chinchillas were born in that period, out of which ca. 200 were used for the research. The data helped to conduct an analysis of a 3-factor variance using the following model:

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

where:

Y_{ijkl} - value of the feature under research in a single animal,
m - average of the population,
a_i - fixed effect of the year of the license,
b_j - fixed sex effect,
c_k - fixed effect of origin (genetic group),
e_{ijkl} - random error.

Hereditability of the features was calculated according to the components of changeability in fathers and mothers. A mixed model [4] was used:

$$\mathbf{Y_{ijkl}=m+a_i+b_{ij}+r_k+e_{ijkl}}$$

where:

Y_{ijkl} - observation of a feature of animal l in year k from mother subgroup j and father subgroup i,
m - average of the population,
a_i - random father effect,

b_{ij} - random mother effect,
r_k - fixed effect of the year,
e_{ijkl} - random error.

Due to the fact that the features of animals vary slightly and differ from regular distribution probite transformation of the hereditary factors arrived at was used [14].

RESULTS AND DISCUSSION

The analysis of variances showed a highly relevant influence of the year of birth and a relevant influence of sex on the size of chinchillas. The year of birth showed a relevantly high influence on the evaluation of the belly-belt and the purity of colour, high influence on the structure of fur, colour and total number of points. The sex highly influenced the structure of fur and total sum of features. The origin of animals did not influence their individual features, but only the total number of points.

Table 1 presents arithmetic mean values and changeability factors of all examined features. The statistic characteristic is presented separately and jointly for both sexes. The arithmetic mean values of the features were characterised by a large span in the years, but it is difficult to observe any defined tendency. It happened in both the females and males. The average grades for purity of colour and belly-belt were similar in both males and females, in case of other features they varied depending on the feature - they were higher in one or the other sex. General mean values of the features which were analysed were as follows: size - 2.79, structure of fur - 8.07, purity of colour - 8.34, colour - 5.64, belly-belt - 2.65, the total of points was 27.54. The estimated mean values for the size of animals were slightly lower and for the fur higher than those presented by Socha and Antolik [13].

Table 1. Static characteristics of the features of chinchillas ($\bar{x}$ - mean value, v – changeability factor)

Feature	Year of evaluation	Sex				Total	
		Males		Females			
		$\bar{x}$<>	v	$\bar{x}$<>	v	$\bar{x}$<>	v
Size of animals	1995	2.94	8.16	2.83	13.43	2.89	11.07
	1996	2.84	13.03	3.00	0.00	2.92	9.25
	1997	2.22	39.64	2.90	11.03	2.46	32.11
	1998	2.75	22.18	3.00	0.00	2.81	19.22
	Total	2.70	23.33	2.93	8.87	2.79	17.92
Structure of fur	1995	7.89	5.96	8.11	3.95	8.00	5.13
	1996	8.32	6.97	8.26	6.78	8.29	6.88
	1997	7.33	16.23	8.60	8.14	7.79	15.40
	1998	8.13	9.10	8.13	10.21	8.13	9.23

	Total	7.93	10.72	8.25	7.03	8.07	9.29
Purity of colour	1995	8.33	5.88	8.33	5.88	8.33	5.13
	1996	8.47	6.02	8.26	6.78	8.37	6.88
	1997	7.89	10.52	8.20	11.22	8.00	15.40
	1998	8.79	5.80	8.88	3.94	8.81	9.23
	Total	8.41	7.97	8.36	7.42	8.34	9.29
Colour of fur	1995	5.83	6.52	5.83	6.52	5.83	6.52
	1996	5.68	8.45	5.68	8.45	5.68	8.27
	1997	5.44	11.40	5.90	5.42	5.61	10.16
	1998	5.46	10.55	5.25	13.52	5.41	11.28
	Total	5.59	9.66	5.71	8.76	5.64	9.41
Belly-belt	1995	2.50	20.40	2.56	19.92	2.53	20.16
	1996	2.37	21.10	2.42	21.07	2.39	20.92
	1997	2.89	11.07	3.00	0.00	2.93	8.87
	1998	2.83	13.43	2.88	12.15	2.84	13.03
	Total	2.66	18.05	2.64	18.56	2.65	16.23
Total	1995	27.56	4.17	27.67	3.04	27.61	3.59
	1996	27.68	5.53	27.63	4.38	27.66	4.92
	1997	25.78	10.43	28.60	5.77	26.79	10.12
	1998	27.92	6.23	28.25	5.91	28.00	6.07
	Total	27.29	7.33	27.91	4.62	27.54	6.32

The mean values are presented in Figs. 1 - 6. The graphs take into account varied genetic groups of the animals. The results led to the conclusion that the grades for body size in the years 1995-1996 and 1998 were similar, and lower only in 1997. Half-imports were graded highest (2.4 - 3 points), whereas imported animals were graded lowest and they were not graded in 1998. In case of fur structure, the results were similar to those relating to the size of animals, i.e. the grades were lower in 1997. The purity of colour and colour in native animals and half-imports was graded close to maximum. In the imported animals there were notable variations noticed in 1997. Proper belly-belts (3 points) were observed in native and imported animals in 1997, and in half-imports in 1998, in other groups there were variations from the model.

Fig. 6 presents the analysis of total of grades. In 1995, 1996 and 1997 native animals received highest grades, whereas in 1998 half-imports received highest grades. Imported animals were graded lowest in all the years.

Fig. 1. Mean values for the size of chinchillas

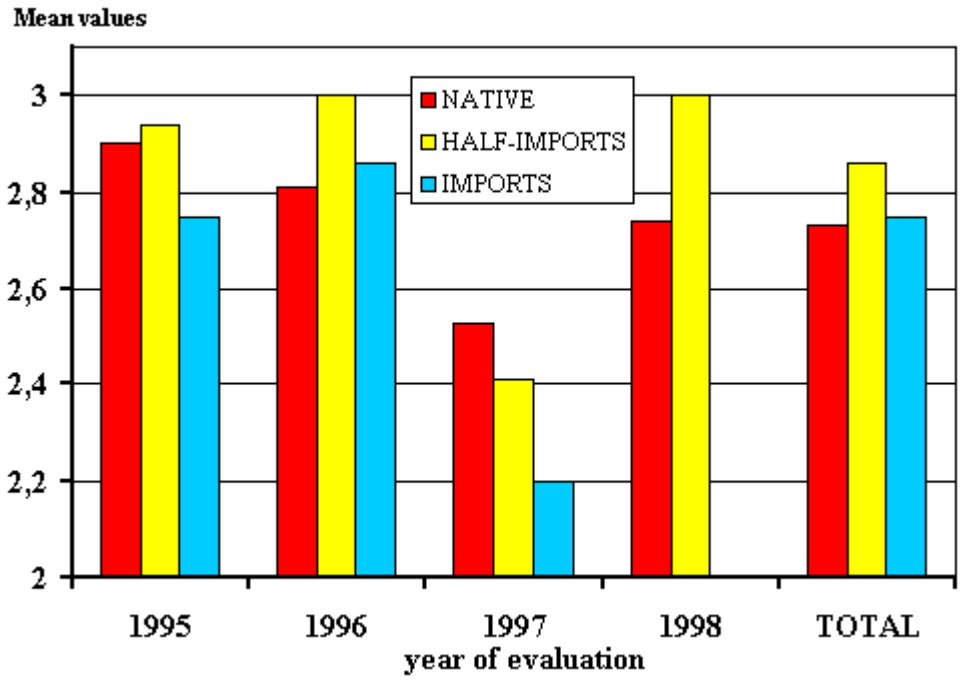


Fig. 2. Mean values for fur structure

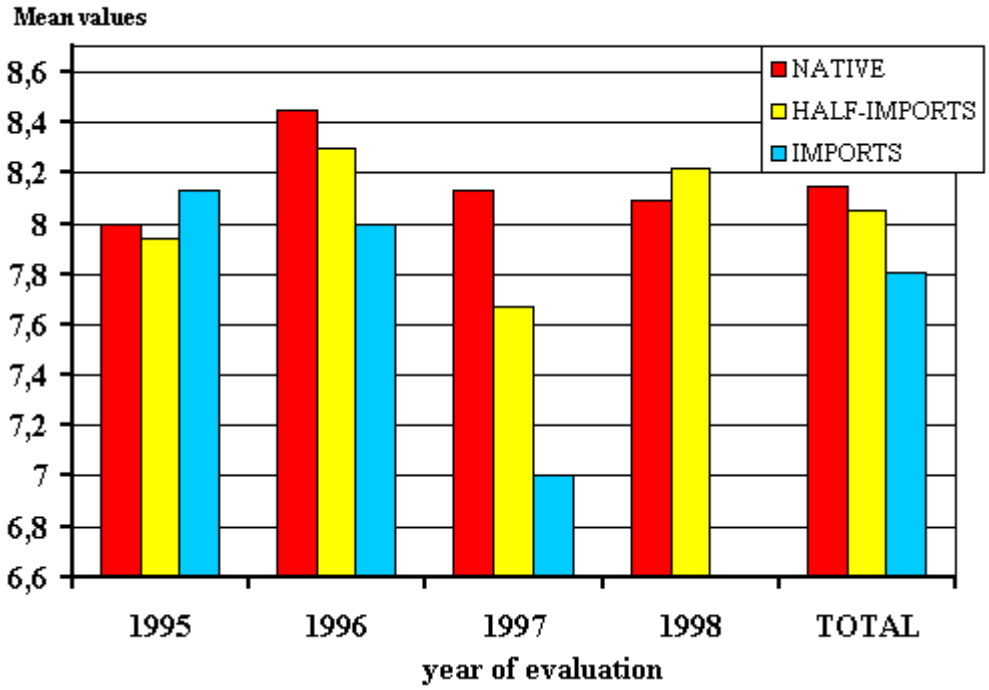


Fig. 3. Mean values for the purity of colour

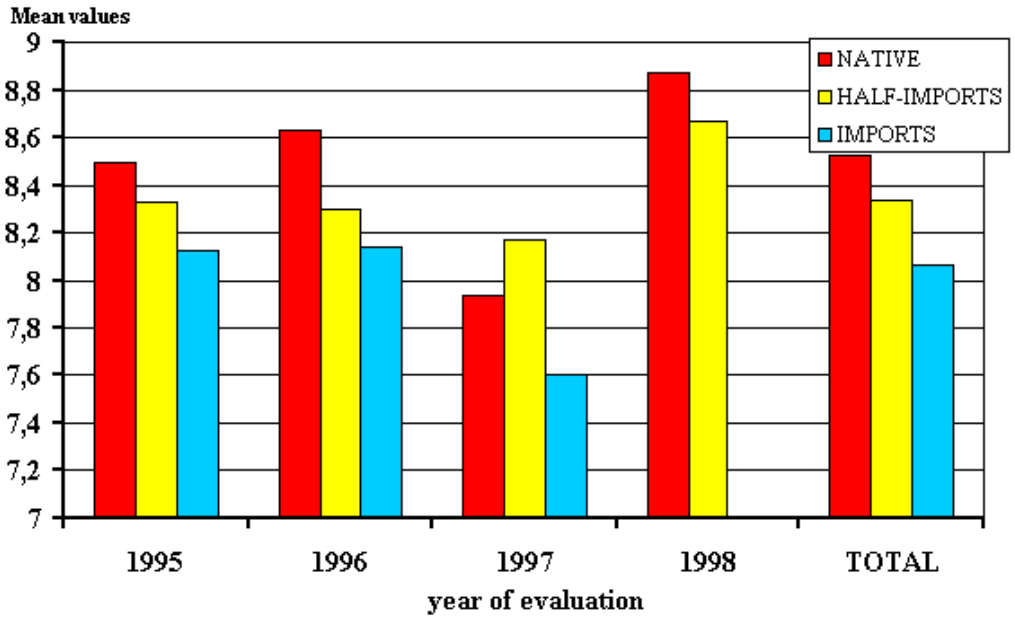


Fig. 4. Mean values for fur colour

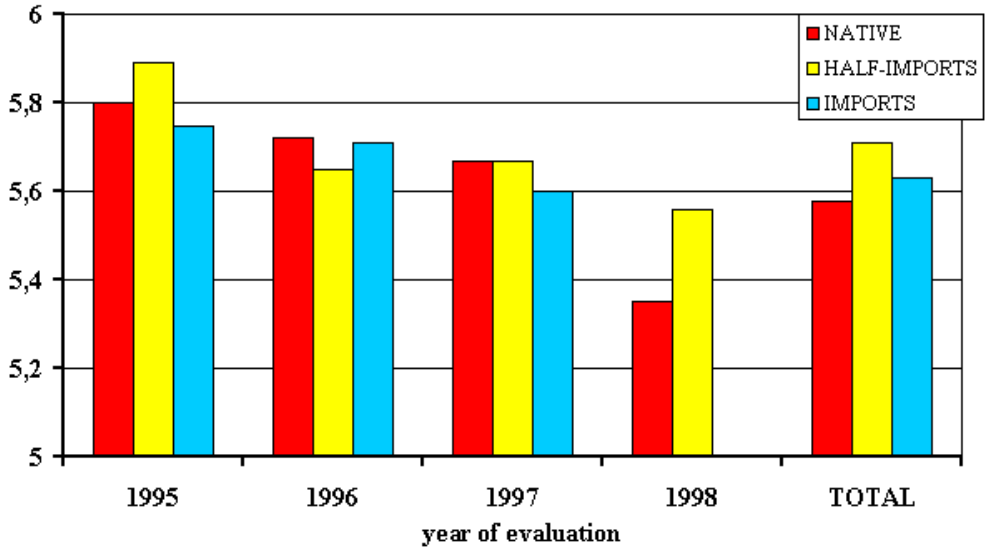


Fig. 5. Mean values for belly-belt

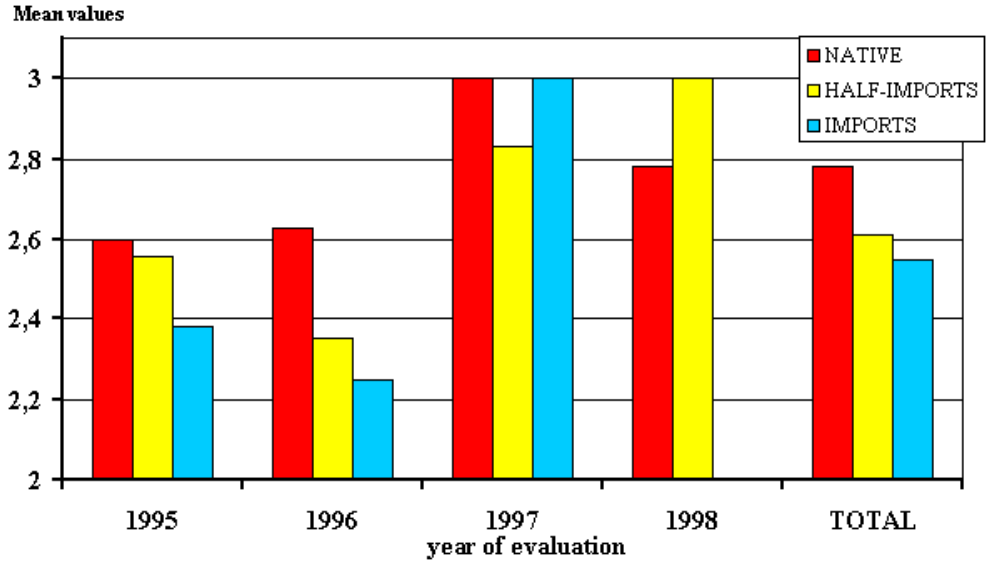
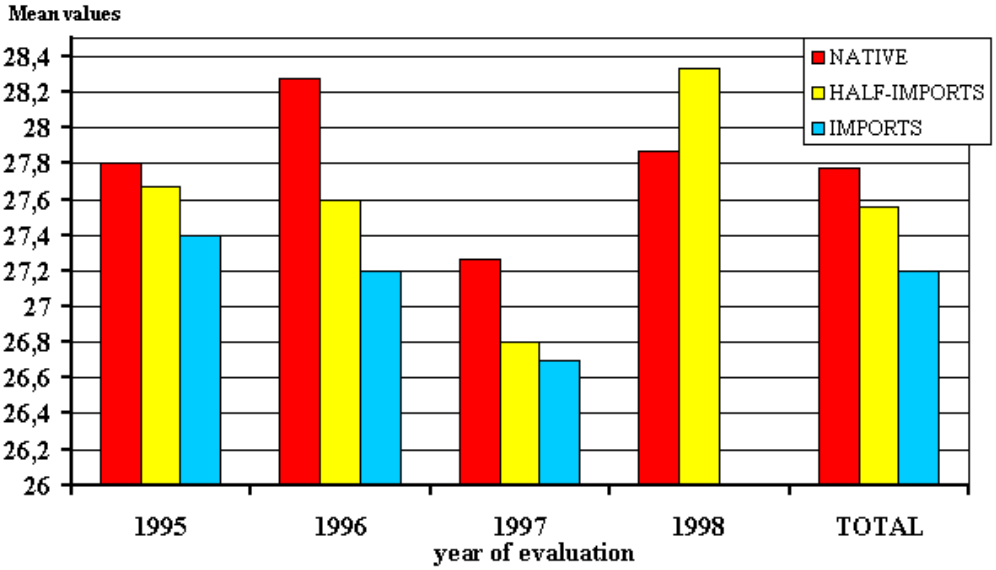


Fig. 6. Mean values for total of evaluation



As different grading rules were used for different features, they are presented as a deviation from the maximum of 100 points. Fig. 7 takes into account the influence of sex and Fig. 8 of the origin of animals. The results show that there were statistically significant differences between grades for the males and females and they were 89% in males and 97.7% in females. Both sexes are characterised by the same growth rate up to the 8th month of life. At later periods males have a bigger size and mass of the body than females.

In females higher mean values were also noted for such features as structure of fur (91.7%), colour (95.2%) and total grade (93%). For other features, the mean values were higher in the group of males (purity of colour - 93.4%, belly-belt - 88.7%).

Fig. 7. Mean grades for features in the years 1995-1998 as % of maximum grades

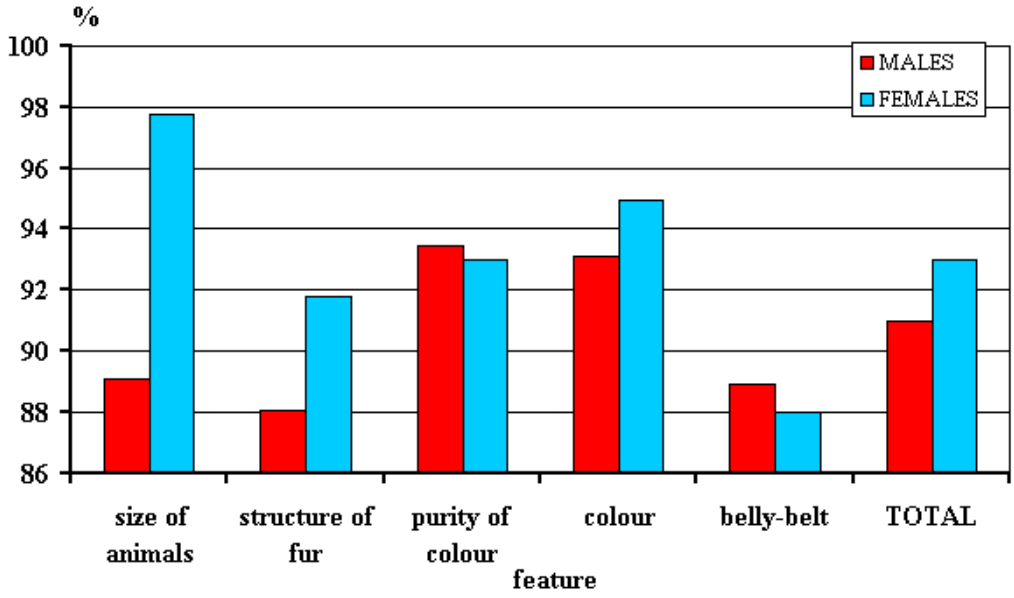
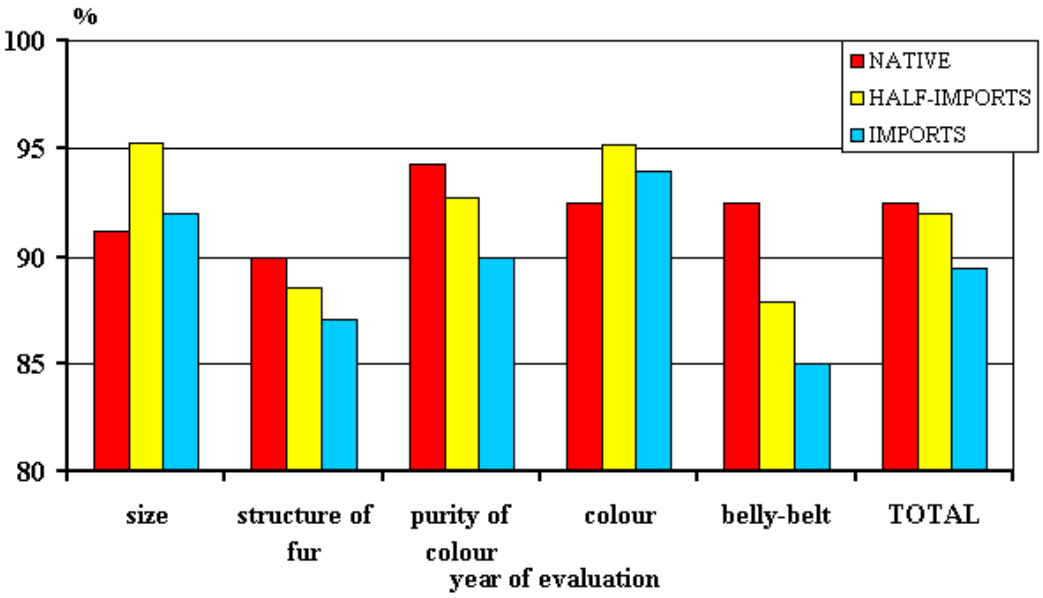


Fig. 8. Mean grades for features in relation to the origin of animals as % of maximum grades



The data indicate that, depending on the origin, the mean grades for the size of animals and fur were only slightly different (the differences were not statistically significant). Native animals were graded highest for the following features: structure of fur (90.6%), purity of colour (94.8%) and belly-belt (92.7%). In case of half-imports the grades were highest for the size (95.3%) and colour of fur (95.2%). In case of imported animals, the grades were lowest and varied between 85 and 93.8%.

There are a few reasons why imported animals were graded lower. It may be due to the fact that the imported animals did not sufficiently adapt to our environment conditions or that selection procedures are different in Poland and in the countries from which chinchillas originate. In Poland, uniform criteria were used for grading the animals.

Another reason for lower grades for the animals referred to as imported may be that all the animals from the group were graded as genotypes which are very valuable for breeding due to the fact of their origin. In the group of animals referred to as native, there was a primary selection and the animals with notably lower values were not graded.

Changeability of factors was also analysed in the research. In males, the parameter for all the features was growing up to the year 1997 and since 1998, a decrease was noted. In the group of females, the parameter was growing in 1998 for the following features: structure of fur, colour and total of grades. Changeability of the belly-belt was higher in females (18.56%) and in males changeability of other features was higher (size - 23.3%, structure - 10.72%, purity of colour - 7.97%, colour - 9.66% and total of grades - 7.33%). The total of grades was characterised by proportionally lowest changeability. It indicates that the animals with lower values of some features had higher values other features and the diversity was lower in complex evaluation.

The changeability, which was slightly higher in males than in females, may indicate that the criteria used for grading males were stricter than those used for grading females. Bigger differentiation among males could also make it easier to select them for further breeding [12].

In order to define the degree of influence of genetic qualities on the features which were analysed, hereditary indices were assessed (Table 2). The index of size hereditability was 0.233, of fur structure - 0.220, of colour - 0.181, purity of colour - 0.231 and of belly-belt - 0.167. The indices are characterised by relevantly high standard errors, which is caused by small number of animals used for assessment.

Table 2. Hereditability factors (after probite transformation) and standard deviations

Feature	Hereditability (h^2)	Standard deviation $V(h^2)$
Size of animals	0.233	0.210
Fur structure	0.220	0.205
Purity of colour	0.231	0.209
Colour	0.181	0.180
Belly belt	0.167	0.161

The parameters are usually lower than those presented by Socha and Antolik [13] which were as follows: for structure – 0.913, for purity of colour – 0.316, for colour – 0.457 and for belly-belt – 0.126. Hereditability of fur features in chinchillas was also assessed by Cappelletti and Rozen [3] and the parameters were as follows: colour – 0.66, general look – 0.48, shape of the body – 0.19, purity of veil – 0.80, purity of undergrowth – 0.88, mass of the body – 0.48, veil on the back – 0.65, veil on the sides – 0.22 and veil on all body – 0.62.

When compared with the hereditability of features in other fur animals, the parameters are characterised by varied values. They are lower for minks [1, 2, 7, 8] and polar foxes [11, 12]. They are comparable with the parameters presented by Filistowicz et al. [5, 6] in the population of foxes.

The parameters of hereditability presented in the present research are relatively low. It indicates that phenotype differences between features are mainly caused by the influence of environment. Low participation of genetic changeability in general changeability shown, among others, through low hereditability may have two reasons. The first is that chinchillas are highly homozygotic although interbreeding is not practised at the farm. New animals have to be introduced into the farm in the future if progress in breeding chinchillas with better fur is to be made. Then, the desired genotypes could be obtained through proper breeding activities and selection. The animals should be provided with appropriate living conditions. Such actions will, undoubtedly, bring about progress in breeding and production as far as the size of chinchillas and the quality of their fur is concerned.

SUMMARY AND CONCLUSIONS

The analysis of changeability of the size of animals and quality of fur in chinchillas allows for drawing the following conclusions:

1. Analyses of variances showed a substantial influence of the year of birth on all the features that were analysed (size of animals, purity of colour, structure of fur, belly-belt and total of grades). The origin (genetic group) did not influence the individual features but only the general grading of animals. The results that were obtained show a substantial influence of environment on the features that were analysed.
2. Arithmetic mean values of individual features in the years varied substantially in both males and females. In all the period higher mean values were observed in the group of native animals, and were between 27.3 and 28.3, in the group of half-imports they were between 26.8 and 28.3, in imports between 26.7 and 27.4. Other features of native animals were also higher, but the differences were not statistically significant. Lower rating of imported animals may indicate an insufficient adaptation to local breeding conditions or differences between selection procedures in Poland and in the countries of their origin.
3. Colour of animals had the highest mean values – ca. 93 – 95% (depending on sex) of maximum for the feature, belly belt and structure of fur had the lowest mean values – ca. 88 – 89% and 88 – 92%, respectively (depending on sex).
4. There were high variations between the coefficients of changeability of analysed features and they varied from 0% to 40% (no matter what the sex or origin of animals). The proportionally lowest values were for the total of grades – ca. 3 –10%. It indicates that the animals with lower values for some features had higher values for other features.
5. The existing phenotypic differentiation of features may stem from the influence of environment. It is proved by low hereditability ratings (from 0.167 to 0.233 depending on the feature). In order to arrive at bigger genetic variability new chinchillas should be introduced to the farm. Then, the desired progress in features of animals may be arrived at through proper breeding and methods of selection.

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