

# EFFECT OF SELECTION AND MATING MICE MAINTAINED ON CHANGED DIETS

Effekt der Selektion und Paarungen von mit geänderten Rationen  
gefütterten Mäusen

Effet de sélection et de croisement chez les souris élevées  
avec des régimes changés

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In many countries the system of improvement of livestock is based on the use of pedigree stock in which the breeding standards are much higher. If the differences in feeding and husbandry conditions between improved and improving animals are very high it may be assumed that the discussed system of improvement of animals will not produce the expected results. This trial is intended to reconstitute the system of improvement of livestock in some countries.

The first step towards the objective consists in estimations of the result of selection on an outbred populations of mice receiving different levels of protein in the diet. One experimental group was fed with pelleted food containing 20 % of crude protein, the other with food containing 10 % of crude protein. Both groups were selected at the age of five weeks, for an up ward direction as regards live weight. Every group consisted of 20 adult individuals (10♂ + 10♀) and of their progeny in two replications. Both experimental groups had a corresponding unselected control population. Selection in the experimental groups was carried out within litters throughout 12 successive generations. This procedure as well as the system of mating provided a protection against inbreeding.

A distinct difference has been noted in the heritability of weight, between mice kept on the two diets. Mice provided with food containing 20 % of protein showed a heritability higher than mice on a low-protein diet (10 %).

Heritability ( $h^2$ ) of mice selected on a high-protein diet:

males 0.223 ± 0.08  
females 0.279 ± 0.06

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Heritability ( $h^2$ ) of mice selected on a low-protein diet:

males  $0.127 \pm 0.08$   
 females  $0.132 \pm 0.10$

After carrying out selections on 12 generations, a half of the animals from each group was transferred to a different nutritional level (from high to low, from low to high). After the change of nutrition levels (for a half of the experimental animals) the selection was carried out in an analogous way for further 7 generations.

Mice transferred after 12 generations of selection from the high to low nutrition level proved to be lighter at the age of 5 weeks than mice selected always on the low protein level (table 1). The differences are statistically significant, both as regards the weight of males and females. The mean response to selection in changed nutritional conditions between the 13th and 19th generation was very small for males  $+0.54$  g and negative for females  $-0.86$  g.

TABLE 1  
 LIVE WEIGHT OF MICE IN CHANGED NUTRITIONAL CONDITIONS

Groups	Males			Females		
	Mean live weight of mice, from 13th to 19th generations			Mean live weight of mice, from 13th to 19th generations		
	$\bar{x}$	<i>Sd</i>	<i>Rs</i>	$\bar{x}$	<i>Sd</i>	<i>Rs</i>
<i>H</i> ... ..	21.34	3.73	+ 1.52	17.98	3.34	+ 0.97
<i>L</i> → <i>H</i> ... ..	22.07 <sup>+</sup>	3.74	+ 2.23	18.98 <sup>+</sup>	2.72	+ 1.97
<i>L</i> ... ..	13.28	4.86	+ 1.19	11.98	3.61	+ 0.63
<i>H</i> → <i>L</i> ... ..	12.63 <sup>+</sup>	5.61	+ 0.54	10.49 <sup>+</sup>	4.04	- 0.86
<i>CH</i> ... ..	19.84	3.46	—	17.01	3.08	—
<i>CL</i> ... ..	12.09 <sup>++</sup>	4.38	—	11.35 <sup>++</sup>	3.76	—

*H* = Mice selected on high-protein diet.

*L* = Mice selected on low-protein diet.

*L* → *H* = Mice selected 12 generations on low-protein diet and transferred to a high-protein diet.

*H* → *L* = Mice selected 12th generations on high-protein diet and transferred to a low-protein diet.

*CH* = Control mice (unselected), maintained on a high-protein diet.

*CL* = Control mice (unselected), maintained on a low-protein diet.

$\bar{x}$  = Mean; *Sd* - standard deviation; *Rs* - mean response to selection from 13th to 19th generation.

<sup>++</sup> = Statistically highly significant differences.

<sup>+</sup> = Statistically significant differences.

— = No statistically significant differences.

When transferring mice from a low protein diet to a high one, obtained were animals heavier, than those always kept on high protein diets. The differences were significant for both males and females. The mean response to selection was also higher in the group transferred from a low to high protein diet.

Another experiment was conducted to complete the results of the trial. One of the groups of mice was selected and maintained on a feed with 20 % of crude protein, the other on a feed with 10 % of erude protein, while in the third group, which was established in the third generation, females and their offspring were fed with the low-protein diet and mated with males from the first group maintained on the high-protein diet.

Selection within litters of three groups of mice was carried out for live weight gains of animals between the third and sixth week of age. All the selected groups were of the same size, they comprised 10 parent pairs in four replications (together 40 ♂♂ + 40 ♀♀) and the offspring. Every experimental group had a corres-

TABLE 2  
MEAN WEIGHT GAINS OF MICE AFTER 8 SELECTED GENERATIONS

Groups	Males				Females			
	<i>n</i>	$\bar{x}$	<i>Sd</i>	<i>Rs</i>	<i>n</i>	$\bar{x}$	<i>Sd</i>	<i>Rs</i>
<i>H</i> ... ..	944	13.11	1.96	+ 0.60	988	9.77	1.46	+ 0.84
<i>CH</i> ... ..	1027	12.51 ++	1.77	—	927	8.93 ++	1.48	—
<i>CL</i> ... ..	610	8.10 ++	3.15	—	636	6.95 ++	2.38	—
<i>L</i> ... ..	673	8.13 -	3.02	+ 0.03	633	7.08 -	2.36	+ 0.13
<i>H</i> × <i>L</i> ... ..	379	7.35 ++	3.36	- 0.75	412	5.80 ++	2.58	- 1.15

- H* = Mice selected on high-protein diet.
- L* = Mice selected on low-protein diet.
- H* × *L* = Progeny of females selected on a low-protein diet and of males selected on a high-protein diet.
- CH* = Control mice (unselected), maintained on a high-protein diet.
- CL* = Control mice (unselected), maintained on low-protein diet.
- Rs* = Mean response to selection.
- $\bar{x}$  = Mean.
- Sd* = Standard deviation.
- ++ = Statistically highly significant differences.
- + = Statistically significant differences.
- = No statistically significant differences.

ponding unselected control population. This part of the trial has 8 selected generations.

Present findings clearly indicate that mating of females selected on low-protein food with males selected on high-protein food is not successful. In the group where females and their offspring were fed with the low-protein diet and mated with males from the group maintained on the high-protein diet, the weight gains of mice were lower than in group where both males and females were selected and maintained on the low-protein diet. The differences are significant for both males and females. The mean response to selection was negative in the third group for both males and females.

In both trials when the animals were transferred from a high-protein diet to a low-protein diet, the result was not satisfactory.

## ZUSAMMENFASSUNG

Selektionsuntersuchungen wurden an nicht ingezüchteten Mäusen durchgeführt. Die Tiere waren mit unterschiedlichen Proteingaben gefüttert (10 % and 20 % Proteingehalt in pelletiertem Futter). Eine Gruppe wurde bei Fütterung von niedrigen (10 %) und die zweite von hohen (20 %) Proteingehalt in den Rationen selektiert auf Erhöhung des Gewichtes im Alter von 5 Lebenswochen.

Nach der Selektion während 12 Generationen eine Hälfte der Mäuse wurde von den proteinreichen Futter aufgaben mit niedrigen Proteingehalt und umgekehrt eine Hälfte von den proteinarmen Futter auf das proteinreiche umgestellt. Nach dem Futterwechsel die Hälfte der Tiere wurde in gleicher Weise wie vorher im Laufe von 8 Generationen weiter selektiert.

Die von proteinreicher auf proteinarme Fütterung umgestellte Mäuse zeigten niedrigere Lebendgewichte als die, vom Anfang an unter proteinarmer Fütterung selektierten Tiere. Im Gegensatz die von der proteinarmen auf die proteinreiche Rationen übergestellte Tiere waren schwerer als die ständig proteinreich gefütterte.

In der nächsten Versuchsreihe wurde die Selektion auf grosse Zuwachsraten im Alter von 3 bis 6 Wochen in 3 Mäusegruppen geführt. Eine Gruppe wurde unter proteinreicher, und die zweite unter proteinarmer Fütterung selektiert. In der dritten Gruppe wurden die Muttertiere und deren Nachkommen mit proteinarmen Rationen gefüttert während die Vatertiere von der ersten proteinreich gefütterten Gruppe genommen waren. Als Ergebnis der Einpaarung von Muttertieren die aus der proteinarm gefütterten Selektionsgruppen genommen wurden mit den Vatertieren, die von den proteinreich gefütterten Gruppen stammten, hatte man bei den Nachkommen die niedrigsten Zuwachsraten im Alter von 3 bis 6 Lebenswochen erhalten.

## RESUME

L'expérience est commencée sur deux lots des souris non parentées—A et B. Le lot A est nourri au commencement avec du régime I qui se caractérise par le niveau bas de protéine (10 %) et le lot B—avec du régime II riche en protéine (20 %). Tous les souris sont sélectionnées pour le poids vif maximum atteint en âge de cinq semaines. Quand on obtient 12 générations, on change les régimes alimentaires pour la moitié des souris de chaque lot, et on continue la sélection par 8 générations successives. La moitié des souris provenant de lot A nourrie avec le régime II atteint le poids vif plus bas que celle de lot B restée toujours sur le régime II, pendant que la moitié des souris de lot B déplacée sur le régime I atteint le poids vif plus élevé que les souris provenant de lot A restées toujours sur le régime I.

Dans la deuxième partie de l'expérience on fait le croisement entre les mâles provenant de lot B (régime riche en protéine) et les femelles de lot A (régime pauvre en protéine) et on élève la progéniture sur le régime I. On fait la sélection entre le 3ème et le 6ème semaine pour le gain de poids vif maximum et on compare les résultats avec ceux obtenus dans les lots fondamentaux A et B (contrôle). On trouve que les souris provenant du croisement se caractérisent par le gain de poids vif le plus bas.

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