GENOTYPIC DIFFERENCES IN PHOTOPERIODIC REACTIVITY OF MINK REPRODUCTIVE SYSTEM OUT OF BREEDING SEASON

Différences génotypiques dans la reactivité photopériodique sur le système reproductif du vison hors de la saison de la reproduction

Diferencias genotípicas en la reactividad fotoperiódica del sistema reproductor del visón, fuera de la estación de la reproducción

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Color mutations in mink have a wide pleiotropic effect which modifies their reproductive function (1, 2). Usually, the breeding season in color minks comes later and their fertility is lower than in Standard ones. Additional illumination during pregnancy by stimulating endocrine functions increases significantly fertility in color minks (3).

It may be suggested that the optico-neuroendocrine mechanism, which responds sensitively to any modification of photoperiodic conditions, is different in minks with various genotypes. Of special interest would be a study of the reproductive system in minks under the influence of photoperiodic conditions out of the breeding season, which gives the possibility to detect more distinctly genotypic differences in reactivity to light.

Standard, Hedlund, Saphire minks 0.5 and 1.5 years of age were kept for 2 weeks under prolonged (17 hours) illumination, provided by 200 watt incandescent bulbs (150-200 lux at the level of the upper surface of the cage). Light was switched on at 4 p. m. and off at 1 a. m. Similar control groups were kept under short natural day light, which at this period was about 8 hours. Treated and control groups are characterized in Table I. The treated minks were sacrificed after 2 weeks of illumination at the same time as controls. The ovaries, uteri and adenohypophyses were removed and weighed on torsion balance. The adenohypophyses, after acetone dehydration, were used for bioassay of the folliclestimulating hormone (FSH) by the method of STEELMAN and POHLEY (4) (Standard - NIH-FSH-S8), Luteinizing hormone (LH) by the method of PARLOW (5) in the modification of BELL *et al.* (6) (Standard - NIH-LH-B7). For bioassay of luteotropic hormone

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TABLE I

CHARACTERISTIS OF EXPERIMENTAL AND CONTROL MINKS

Genotype	Age (years)	Groups	Total No. in group	Initial weight $M \pm m$ (g)	Weight at sacrifice $M \pm m$ (g)	Weight changes treated minks (beginningend of experiment) g	%
Standard	1.5	C *	30	908 ± 27	903 ± 30	+ 3	0.3
		E *	29	915 ± 30	918 ± 26		
	0.5	C	89	957 ± 16	961 ± 14	— 5	0.5
		E	80	947 ± 13	942 ± 15		
Saphire	1.5	C	30	934 ± 22	945 ± 16	— 141 ***	15.2
		E	30	925 ± 19	784 ± 24		
	0.5	C	80	976 ± 15	969 ± 18	— 66 ***	6.8
		E	67	960 ± 14	894 ± 13		
Hedlund	1.5	C	28	940 ± 30	937 ± 25	— 157 ***	16.7
		E	28	937 ± 25	780 ± 25		
	0.5	C	90	904 ± 13	890 ± 12	— 98 ***	10.8
		E	70	900 ± 10	802 ± 12		

C * = Control, E * = Experimental groups.

Significance of differences between initial and sacrifice weight of treated minks *** $P < 0.001$.

(LTH) by the method of NICOLL (7) adenohypophyses stored on ice for not more than 4 hours were used. Standard was «Prolactin» (U. S. S. R.).

RESULTS AND DISCUSSION

The weight of colored minks kept in cages at — 15 — 30 C under additional illumination decreased significantly. Standard minks maintained under the same conditions had no weight differences (Table I). Additional illumination activated the sexual system of minks, which was expressed in an increase of uterus weight of adult Standard, Hedlund, Saphire minks by 2, 40 and 35 % respectively; in the young ones by 54, 58 and 47 % as compared with controls. Ovary weight did not change under the influence of additional illumination (Fig. 1).

It was found that under natural conditions only in Standard minks was there a considerable correlation between uterus weight and body weight, whereas in color minks this correlation was negligible. However, under additional illumination, this correlation increases considerably in color minks, but decreases in Standard ones (Table II). This result may be explained by different correlation between body weight loss (energy expenditures) and photoperiodically stimulated

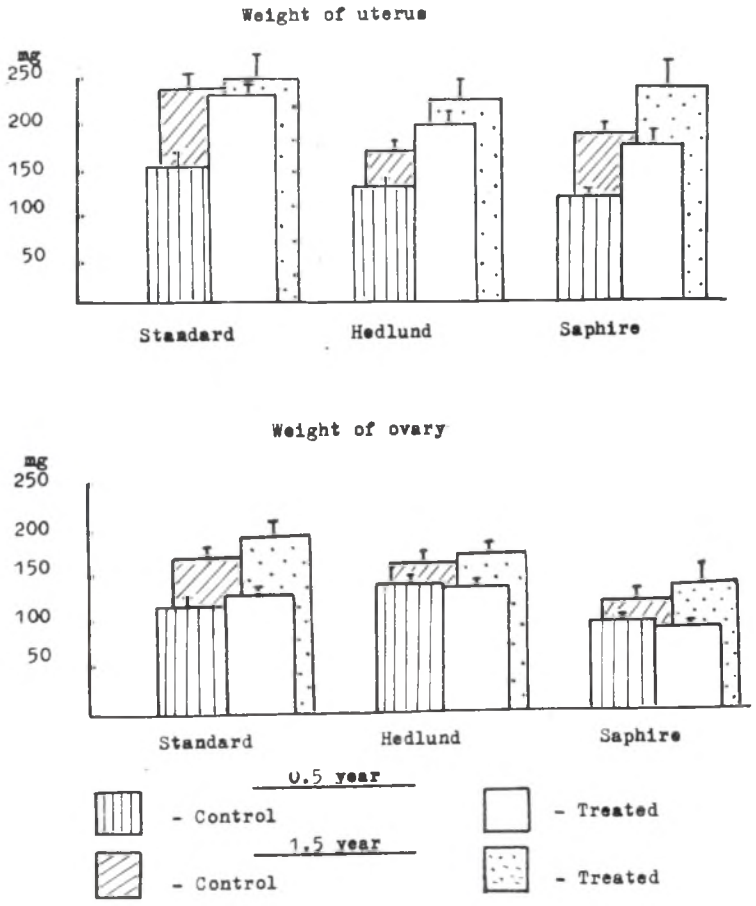

FIG. 1. Influence of photoperiodic conditions on the weight of ovary and uterus in mink of different genotypes

hormonal levels in Standard and color minks. Thus, under additional illumination in Standard minks of small and large body weight occurs almost the same increase of uterus weight, which indicates that hormonal stimulation of the proliferative processes in the uterus are relatively independent from energy balance. As for color minks with small weight, there was a slight increase in uterus weight unde rthe influence of illumination; as the live weight increases so does the degree of increase of uterus weight, which evidences a strong dependence of photoperiodic hormonal stimulation of the uterus on energy supply (Fig. 2).

This differences in uterus photostimulation in Standard and color minks suggest to some peculiarities of estrogenic activity of their ovaries.

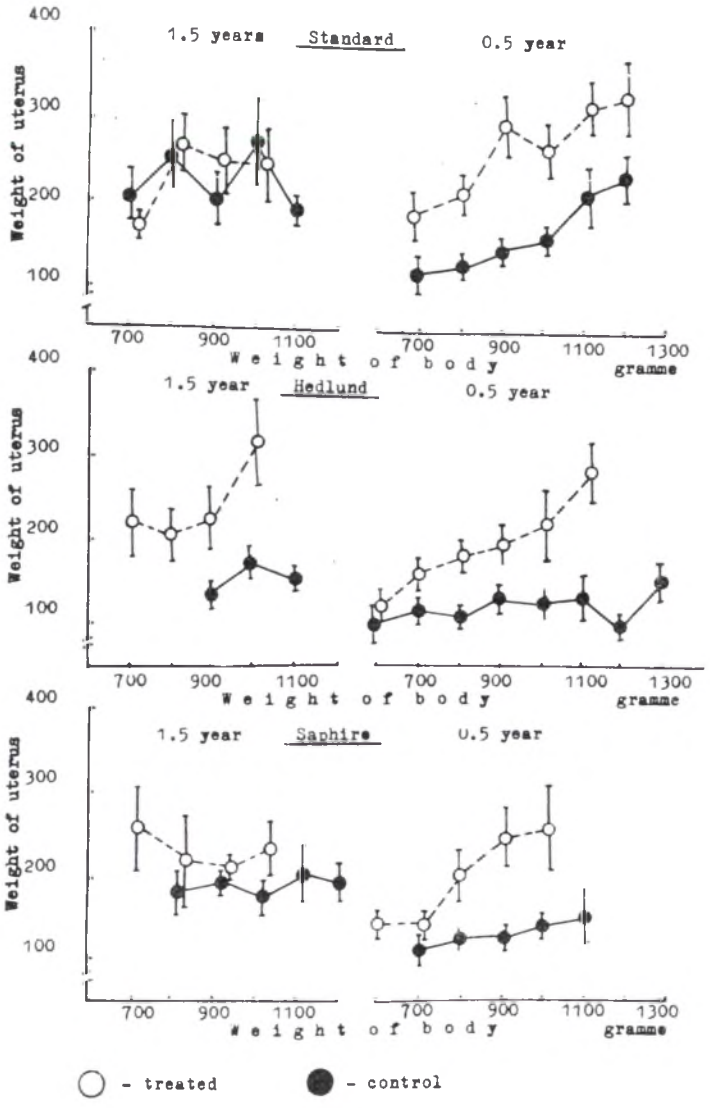

FIG. 2. Correlation of body weight and uterus in mink under different photoperiodic conditions

It may be assumed that genotypic peculiarities of morpho-physiological reactivity of the ovary and uterus to illumination are mediated by functional changes in the hypothalamo-hypophyseal apparatus. One of the indices of the function of this apparatus could be the concentration of gonadotropic hormones in the hypophysis. Indeed, prolongation of day light in winter, out of the breeding sea-

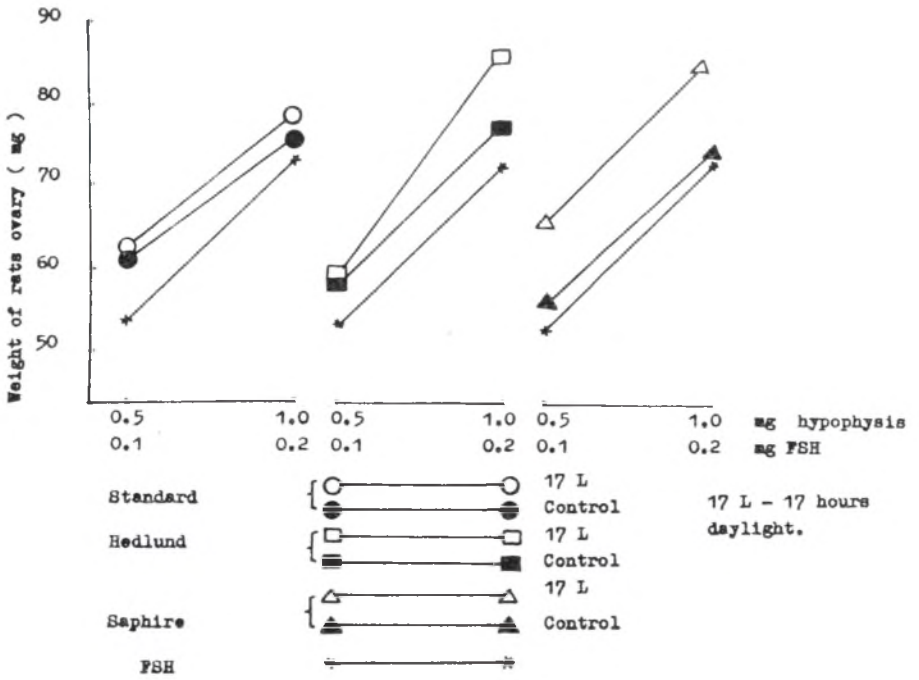

FIG. 3. Increase of weight of ovary of rats under the influence of different doses of FSH and hypophyses homogenates in mink under different photoperiodic conditions

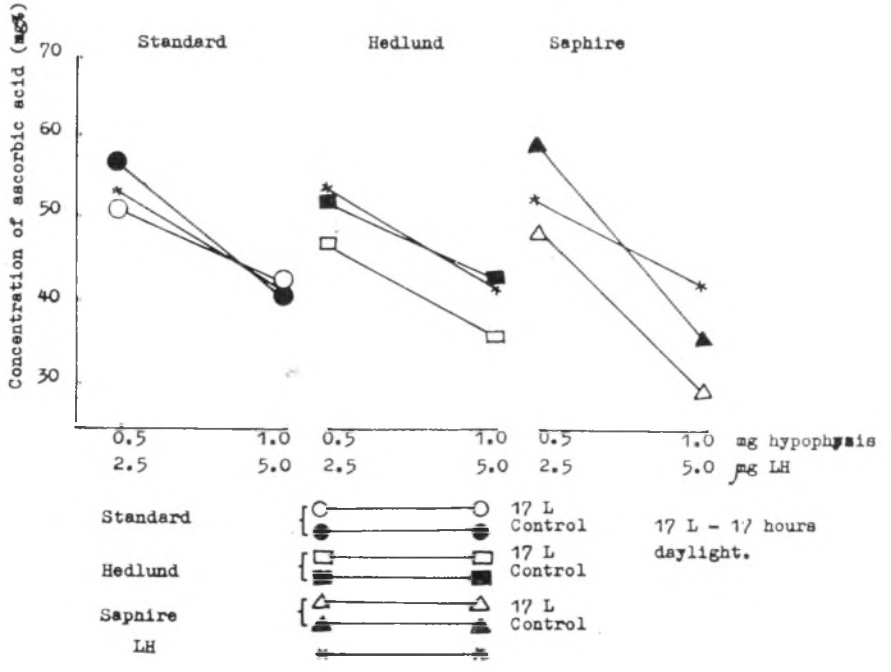

FIG. 4. Concentration of ascorbic acid in ovary of rats under the influence of different doses of LH adenohyphyses homogenates of mink under different photoperiodic conditions

TABLE II

CORRELATION BETWEEN BODY WEIGHT AND WEIGHTS OF OVARY AND UTERUS IN MINKS MAINTAINED UNDER DIFFERENT ILLUMINATION CONDITIONS

Genotype	Age (years)	Groups	Total No. in group	*r* — weight of ovary — body weight ± m_r	*r* — weight of uterus — body weight ± m_r
Standard	1.5	*C* *	30	— 0.01 ± 0.18	+ 0.58 ± 0.15 ***
		E *	29	+ 0.06 ± 0.18	+ 0.27 ± 0.18
	0.5	*C*	89	+ 0.03 ± 0.10	+ 0.42 ± 0.09 ***
		E	80	+ 0.19 ± 0.10	+ 0.34 ± 0.10 ***
Hedlund	1.5	*C*	30	+ 0.08 ± 0.18	+ 0.05 ± 0.18
		E	30	+ 0.10 ± 0.18	+ 0.37 ± 0.18 *
	0.5	*C*	80	+ 0.09 ± 0.10	+ 0.13 ± 0.10
		E	67	+ 0.42 ± 0.10 ***	+ 0.41 ± 0.10 ***
Saphire	1.5	*C*	28	+ 0.13 ± 0.18	+ 0.08 ± 0.18
		E	28	— 0.11 ± 0.18	+ 0.18 ± 0.18
	0.5	*C*	80	+ 0.11 ± 0.10	+ 0.20 ± 0.10
		E	70	+ 0.04 ± 0.10	+ 0.29 ± 0.10 **

C * = Control, *E* * = Experimental groups.
Statistically significant at $*P < 0.05$, $** P < 0.01$, $*** P < 0.001$.

son, exerted a strong influence on LTH level in the pituitary. In light treated adult Standard, Saphire, Hedlund minks 87.5, 75.0 and 50.0 % of pituitaries, respectively, had luteotrophic activity. In young ones — 80.0, 77.7 and 44.4 %. In the pituitaries of these adult Standard, Saphire, Hedlund minks where the luteotropic activity was present, it was 0.0098, 0.0030 and 0.0019 I.U. LTH, respectively; in young ones 0.0061, 0.0030, 0.0019 I.U. LTH. In untreated animals no luteotropic activity was found. No significant changes in FSH and LH in adenohypophysis under the influence of light were found in adult Standard, and Saphire minks. However, in the hypophyses of Hedlund minks there was a considerable increase of LH, with unchanging FSH. In immature Hedlund and Saphire minks unlike in Standard ones, there was a tendency to increase of FSH and LH concentration under the influence of additional illumination. Thus, potential folliculotropic activity (FSH, %) of the adenohypophysis in illuminated Standard, Hedlund, Saphire minks was estimated as 25.1 ± 3.5, 26.2 ± 3.6, 28.4 ± 2.7 respectively against 23.2 ± 3.2, 22.7 ± 2.7, 21.3 ± 3.1 in controls. The respective luteinizing activity (LH, %) of adenohypophysis of experimental Standard, Hedlund, Sapphire minks was 0.50 ± 0.04, 0.58 ± 0.06, 0.61 ± 0.06 as compared with 0.49 ± 0.06, 0.49 ± 0.05, 0.52 ± 0.06 in the controls (Figs. 3 and 4).

SUMMARY

Prolongation of day light period in November, December by means of additional illumination with incandescent lamps up to 17 hours for 2 weeks produced an increase in uterus weight in adult Standard, Hedlund, Sapphire minks by 2, 40 and 35 % respectively; in immature minks by 54, 58 and 47 % against the controls.

Under natural conditions, only in Standard minks a correlation was found between body and uterus weight ($r = + 0.58$ in adults and $r = + 0.42$ in young animals). In Hedlund and Sapphire minks this correlation was insignificant. However, under additional illumination, in color minks, due to hormonal stimulation of ovarian function, this correlation increases to $r = + 0.41$ in young Hedlund minks. In light-treated Standard minks, on the contrary, the correlation coeficient decreases.

Bioassay of gonadotropic hormones found a considerable increase of LTH concentration in adenohypophysis under additional illumination. The highest concentration of LTH was in Standard minks. No LTH wes found in the pituitary of the controls at this period. Changes of FSH and LH concentration under the influence of illumination were much smoller, which seems to tell for the leading role of LTH in the photoperiodic sexual reactivity of minks. The results are indicate on the differences in the function of the optico-hypothalamo-hypophysial mechanism in minks of different genotypes.

RESUME

La prolongation de la période à lumière diurne pendant les mois de Novembre et Décembre jusqu'à 17 heures, réalisée par l'illumination additionnelle, avec des lampes incandescentes, au cours de deux semaines, produit un accroissement dans le poids de l'utérus chez les visons femelles adultes Standard, Hedlund, Sapphire, de 2, 40 et 35 pour 100 respectivement; chez les visons femelles pas encore matures, les augmentations furent 54, 58 et 47 pour 100 sur les contrôles.

Sous des conditions naturelles, on n'a trouvé chez le vison Standard qu'une corrélation entre les poids corporel et de l'utérus ($r = + 0{,}58$ chez les adultes, et $r = + 0{,}42$ chez les jeunes animaux). hez les Hedlund et les Sapphire cette corrélation ne fut pas significative. Cependant, avec l'illumination additionnelle, chez les visons à couleur, à cause de la stimulation hormonale de la fonction ovarienne, leurs corrélations augmentent jusqu'à $r = 0{,}41$ chez les jeunes visons femelles Hedlund. Au contraire, chez les visons femelles Standard traitées par la lumière, le coéfficient diminue.

Le bio-essai avec hormones gonadotropes trouva une augmentation considérable de la concentration de LTH dans la adénohypophyse, sous l'illumination additionnelle. On trouva la majeure concentration de LTH chez les visons femelles Standard. On n etrouva pas LTH dans la pituitaire des contrôles de cette période. Les changements en FSH et LH, quant à leurs concentrations, sous l'influence de l'illumination, furent beaucoup plus réduits, ce qui semble indiquer un rôle promoteur du LTH dans la réactivité photopériodique sexuelle des visons femelles.

Les résultats suggèrent aussi la possibilité que les différences dans la fonction du mécanisme optique-hypotalamique-hypophysaire des visons, soient dûes aux différences génotypiques.

RESUMEN

La prolongación del período de luz diurna en noviembre y diciembre por medio de la iluminación adicional con lámparas incandescentes hasta 17 horas durante dos semanas produce un incremento en el pero del útero en las visonas adultas Standard, Hedlund, Sapphire, del 2, 40 y 35 por 100, respectivamente; en visonas inmaturas, los incrementos fueron del 54, 58 y 47 por 100 sobre los controles.

Bajo condiciones naturales, solamente se ha encontrado en el visón Standard una correlación entre los pesos corporal y del útero ($r = + 0{,}58$ en adultos, y $r = + 0{,}42$ en animales jóvenes). En Hedlund y Sapphire esta correlación fue insignificante. Sin embargo, con iluminación adicional, en visones de color, debido a la estimulación hormonal de la función ovárica, sus correlaciones aumentan hasta $r = + 0{,}41$ en visonas jóvenes Hedlund. En visonas Standard tratadas por la luz, por el contrario, el coeficiente de correlación disminuye.

El bioensayo de hormonas gonadotropas encontró un aumento considerable de la concentración de LTH en la adenohipófisis bajo iluminación adicional. La mayor concentración de LTH se encontró en visonas Standard. No se encontró LTH en la pituitaria de los controles en este período. Los cambios en FSH y en LH, en cuanto a sus concentraciones, bajo la influencia de la iluminación, fueron mucho menores, lo que parece indicar un papel promotor del LTH en la reactividad fotoperiódica sexual de las visonas. Los resultados también hacen sugerir la posibilidad de que las diferencias en la función del mecanismo óptico-hipotalámico-hipofisario de los visones se deban a diferencias genotípicas.