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Resting Metabolic Rate of Lactating and Developing Citellus citellus

Metabolizm spoczynkowy u karmiących i u rosnących *Citellus citellus*

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In the females of *Citellus citellus* (Linnaeus, 1758), the *RMR* values are increased by 18% during the 1st and 2nd week of lactation, and afterwards they decrease so that in the 4th—5th week of lactation they are even lower than in the adult ones. During the first 5 weeks of life, the individuals of *Citellus citellus* show increased *RMR* values which gradually decrease and by the 13th week reach values close to those of the adults.

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1. INTRODUCTION

The purpose of the present paper is to determine the influence of lactation on the resting metabolic rate (*RMR*) of females and the influence of growth on *RMR* of *Citellus citellus* individuals. Such determinations are useful for the estimation of the energy flow rate in rodent populations, the more so as *Citellus citellus* is considered as an ecologically important species in the cultivated fields and in the fallow land of Romania.

2. MATERIALS AND METHODS

The test animals were captured in the spring of 1975 (April) from the cropped fields at Valu lui Traian, Dobrudja (28°26′E—44°14′N). In the laboratory, the females brought forth their litter in early May. The 95 *RMR* evaluation were carried out in lactating females from the first day of life of their litter up to weaning. Between the experiments the sucklings were kept with their mothers, the lactating females receiving corn and alfalfa seeds and water *ad libitum*. The young animals were fed on alfalfa, corn and water as soon as they were able to feed on this food in addition to the maternal milk. During the experiments the females were kept for one hour in a metabolic chamber of 11.1 liters.

RMR was recorded in 2 day old sucklings and further up to the age of 27 weeks. In all the 230 determinations performed, the animals were weighed every 3 days and *RMR* was evaluated at the same time intervals. During the first 20 days

RMR determinations were made on groups of 5 individuals each, the animals being kept in a metabolic chamber of 5.6 liters. From this age on the determinations were made individually in metabolic chambers of 5.6 and 11.1 liters, as the weight increased.

For comparison purposes the determinations were made concomittantly on several adult animals captured during the same season from the same locality. After being captured, the adults were kept for 3 days in the laboratory so as to become adapted to these conditions. For the determination of *RMR*, every animal was maintained for one hour in a chamber of 11.1 liters. During captivity, the animals were fed with corn, alfalfa and water *ad libitum*. In adults 22 determinations were made.

Table 1

RMR in females of *Citellus citellus* during the lactation period.

Period	Body weight (g)	*RMR* (kcal/Kg/h)	No. of measurements	*RQ*
Lactation				
1st week	226.0 ± 17.3	13.7 ± 1.9	3	1.01 ± 0.10
2nd week	218.6 ± 31.1	11.9 ± 1.7	11	0.93 ± 0.12
3rd week	199.7 ± 19.0	9.4 ± 2.1	12	0.91 ± 0.20
4th week	196.0 ± 9.9	7.4 ± 0.7	8	0.93 ± 0.18
End of weaning				
5th week	192.3 ± 6.3	7.5 ± 1.3	15	1.07 ± 0.13
6th week	175.4 ± 10.4	7.9 ± 1.5	8	1.02 ± 0.18
7th week	177.7 ± 14.4	8.5 ± 1.7	12	1.01 ± 0.20
Post-lactation				
8th week	169.2 ± 20.5	7.0 ± 0.9	12	0.94 ± 0.15
9th week	164.0 ± 7.6	7.5 ± 1.0	6	0.95 ± 0.19
10th week	195.5 ± 3.8	6.7 ± 1.1	6	0.88 ± 0.12
11th week	187.0 ± 0.0	6.7 ± 0.3	2	0.86 ± 0.19
Adult (non lactating)	174.0 ± 19.7	10.8 ± 1.8	22	0.88 ± 0.16

All *RMR* determinations were made from 8.00 to 11.00 a. m. The *RMR* values were determined on the basis of the O_2 consumption and CO_2 output analyzed by means of a Li_3 interferometer. The experiments were run at 20°C ± 1. The respiratory quotient (*RQ*) was estimated, and *RMR* was expressed in kcal/Kg/h.

3. RESULTS

The data on *RMR*, body weight, and *RQ* are listed in Tables 1 and 2. As compared to non-lactating females, the *RMR* of lactating *C. citellus* females was higher by 18% during the first and second weeks (Table 1). Further, *RMR* decreased during the weaning period (5th—7th week) and persisted at a lower level than that of non-lactating females even up to the 11th week after birth.

The body weight of lactating females presented fluctuations too.

It decreased up to the age of about 6 weeks which corresponds to the weaning period. Rather high fluctuations of the body weight were found even in the 11th week. The high *RQ* levels of about 1.00 recorded in lactating *C. citellus* females showed rather high fluctuations up to the 7th week, time at which they began to decrease and to be close to the *RQ* values of adult animals.

The newly-born *Citellus citellus* opened their eyes when aged 4—5 weeks.

Table 2

RMR in Citellus citellus during postnatal development.

	Body weight (g)	*RMR* (kcal/Kg/h)	No. of measurements	*RQ*
Age, week	Determinations in groups of 5 individuals			
1st	6.5 ± 7.2	7.5 ± 1.1	2	0.58 ± 0.00
2nd	14.4 ± 3.0	8.6 ± 1.8	12	0.67 ± 0.07
3rd	23.2 ± 4.9	9.1 ± 2.7	11	0.66 ± 0.07
	Single individual determinations			
4th	32.7 ± 3.5	13.9 ± 2.0	10	0.75 ± 0.10
5th	42.4 ± 5.0	16.5 ± 2.1	15	0.74 ± 0.14
6th	62.4 ± 9.2	14.5 ± 2.0	10	0.84 ± 0.05
7th	85.8 ± 6.9	13.8 ± 2.9	11	0.93 ± 0.10
8th	99.5 ± 8.0	15.3 ± 2.0	9	0.81 ± 0.19
9th	113.5 ± 6.3	12.5 ± 2.7	11	1.03 ± 0.20
10th	129.9 ± 6.7	13.8 ± 2.6	15	0.94 ± 0.15
11th	143.3 ± 12.5	11.6 ± 2.7	11	0.92 ± 0.22
12th	158.0 ± 19.8	12.0 ± 2.1	11	0.96 ± 0.13
13th	151.6 ± 22.9	10.7 ± 2.0	8	0.84 ± 0.13
14th	162.2 ± 19.0	10.1 ± 1.7	10	0.99 ± 0.13
15th	171.9 ± 15.7	9.9 ± 2.5	7	0.98 ± 0.03
16th	182.4 ± 24.2	10.4 ± 1.6	7	0.93 ± 0.08
17th	186.7 ± 13.7	9.4 ± 1.2	6	0.91 ± 0.08
18th	183.8 ± 11.0	8.3 ± 1.8	9	0.85 ± 0.19
19th	188.2 ± 19.8	6.4 ± 0.8	8	0.99 ± 0.06
20th	197.7 ± 12.4	6.9 ± 0.9	7	0.92 ± 0.13
21th	189.6 ± 13.3	7.6 ± 1.4	5	1.00 ± 0.16
22th	192.2 ± 12.9	7.5 ± 1.1	6	0.87 ± 0.05
23th	196.2 ± 9.9	7.3 ± 1.7	8	0.88 ± 0.08
24th	198.6 ± 10.2	9.3 ± 1.3	9	0.88 ± 0.09
25th	194.0 ± 2.7	11.3 ± 2.7	5	0.89 ± 0.05
26th	200.7 ± 9.7	10.9 ± 2.4	3	0.91 ± 0.20
27th	194.5 ± 2.9	9.6 ± 1.5	4	0.88 ± 0.09
Adult	174.0 ± 19.7	10.8 ± 1.8	22	0.88 ± 0.16

RMR changes during the first 3 weeks (in groups of 5 individuals) were relatively small (Table 2). Peak *RMR* values were recorded in the 5th week (individually, in a metabolic chamber). Further *RMR* decreased, the fluctuations being smaller. Beginning with the 13th week it was equal to that of adult animals but marked fluctuations close to this value occurred. The weight increased markedly and uniformly for 20 weeks,

at this age the weight becoming constant and equal to that of adult animals. Moreover, the *RQ* values increased up to the 9th week. Further, the *RQ* levels remained high, but with marked fluctuations. In 22 week-old animals, the *RQ* values became constant and equal to that of the adult animals.

4. DISCUSSION

The present results on *C. citellus* adults are in agreement with those reported by Kalabukhov (1960) in *C. pygmaeus* Pall., but higher than those found by the same author in *Citellus fulvus* (Licht).

The observations on the lactation and breeding periods of *C. citellus* described here agree well with those reported for other rodent species under similar conditions. Trojan & Wojciechowska (1967) and Myrcha (1975) reported a high increase of the energetic metabolism during the lactation period of *M. arvalis* and the lactation and breeding period of white mice, respectively. High values of the metabolism and high fluctuations of this latter during the breeding period were reported by Vişinescu *et al.* (1965) and Nichita *et al.* (1962) in *Mesocricetus auratus*, by Kleiber *et al.* (1956) and Taylor (1960) in rats and by Rožaja & Maslennikova (1968) in hamsters.

It can be therefore concluded that in all mammals there are differences in metabolism which are related to the age. These appear to be in connection with the efforts of the young organisms to become adapted to environmental conditions differring from the maternal organism, the absence of the hairy coat, the considerable volume of the inner organs and the still unstable chemical regulation (Vişinescu *et al.* 1965). The peak *RMR* values found in 5 week old *C. citellus* correspond to the moment at which the eyes are opened.

The low *RQ* values recorded in the first weeks probably reflect a high rate of metabolization of the nutritive principles obtained from food, and correspond probably to the period when the young animals are fed with maternal milk.

Worth mentioning is the correlation of the evolution of the energetic metabolism to that of the *RQ* values during the lactation period and the early stages of life of *C. citellus*. It is estimated that the high *RMR* fluctuations recorded under laboratory conditions in lacting *C. citellus* females and during the breeding period are related to the fact that this species does not readily become adapted in captivity.

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Circumanal Glands in the European Beaver

Gruczoły przyodbytowe bobra europejskiego

Teresa DOBOSZYŃSKA

Doboszyńska T., 1978: Circumanal glands in the European beaver. Acta theriol., 23, 18: 301—305 [With 1 Table & Plates XXIII—XXIV].

Observations were made of the glands of 19 females and 8 males of the European beaver (*Castor fiber* Linnaeus, 1758) describing their topography and macro- and microscopic structure. It was found that they belong to typical dermal glands of the complex — vesicular-tubular type. Their secretion is formed in vesicles and then passes through the system of efferent ducts and collects in the capacious cavity of the gland. These glands, on account of the way in which the secretion forms, are holocrine glands and produce a greasy, fatty secretion.

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The paired *diverticula laterales fossae preputialis* and pair of fat glands are included in the organs of the beaver situated caudad to the rear of the pelvis. A considerable amount of attention has been given to the first pair up to the present on account of the secretion produced, which is termed musk or castoreum (Hinze, 1950; Kacnielson & Orlova, 1954, 1956; Doboszyńska, 1976).

As stated by Nikulin (1954) and Gienc & Doboszyńska (1972), both pairs of sacs, characteristic of the beaver, lying caudad to the rear of the pelvis under the caudal vertebra, open into the dermal diverticulum together with the anus and vagina, termed by Nikulin (1954) the cloaca, but by Gienc & Doboszyńska (1972) the pseudo-cloaca.

No exact macro- and micromorphological description of the circumanal glands of the beaver has been encountered in the literature available and consequently the purpose of the present study is to determine the structure of these organs in both females and males of different age.

The author made her own studies on the glands of 19 females and 8 males in the following age groups: (1) newborn animals, (2) animals