A C T A T H E R I O L O G I C A

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Caloric Density of the Old-Field Mouse During Postnatal Growth[2]

[With 3 Tables]

Changes in caloric value of old-field mice, *Peromyscus polionotus* (Wagner) were examined during postnatal growth. Caloric value of both ether-extractable fat (*FAT*) and lean dry biomass (*LDB*) was determined using a bomb calorimeter. Changes in caloric density occurred with age (size) in both *FAT* (8.77 to 9.21 kcal/g *FAT*) and *LDB* (4.49 to 4.76 kcal/g *LDB*). Ash-free *LDB* (*AFLDB*) was constant across age (size) with an average value of 5.34 ($2\,SE=0.04$) kcal/g *AFLDB*. Age-specific values of *FAT* and size-specific values of *LDB* were used to estimate total calories in each of 215 mice from 0 to 42 days of age. Caloric density of dry weight biomass (*DWB*) and live weight biomass (*LWB*) increased with size. The range of values was from 5.13 kcal/g *DWB* for 1—2 g mice to 6.27—6.33 kcal/g *DWB* for 12—14 g mice and 0.89 kcal/g *LWB* for 1—2 g mice to 2.23—2.32 kcal/g *LWB* for 11—14 g mice. Caloric density of *LWB* was predictable from g *LWB* by two equations, one for 1—7 g mice (kcal/g $LWB=0.584+0.194$ g *LWB*, $r=0.97$, df=125, $P<0.01$) and another for 7—14 g mice (kcal/g $LWB=0.591+0.134$ g *LWB*, $r=0.70$, df=86, $P<0.01$). Constants of 9.1 kcal/g *FAT* and 5.3 kcal/g *AFLDB* were suggested to convert rodent body composition data to energy equivalents without bombing tissue samples.

I. INTRODUCTION

Ecological energetics studies necessitate the estimation of the caloric density of biomass to calculate energy flow or production of the population(s) in question. Caloric density of live weight biomass is similar for many rodents (Golley, 1960; Davis & Golley, 1963; Górecki, 1965) and an average value for rodents may be sufficient for use in field studies. However, changes in the caloric density of live weight biomass during postnatal development have been documented for

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house mice (*Mus musculus* L.; Myrcha & Walkowa, 1968; Brisbin, 1970). Caloric density of dry weight biomass also changes with age in the common vole *Microtus arvalis* (Pall.); Sawicka-Kapusta, 1970). Since changes in caloric density with age occur, estimation of energy budgets may be greatly affected by the use of an average caloric value rather than a series of age or size-specific caloric values.

Our objective was to examine the caloric density of laboratory-raised old-field mice, *Peromyscus polionotus* (Wagner, 1843) of different ages. More specifically we wanted to analyze the patterns of change in caloric density of lean dry and ash free lean dry biomass, fat, dry weight biomass and live weight biomass during postnatal growth. Secondarily, predictive equations were derived for estimating caloric density of live weight biomass from the live weight of the mice.

II. METHODS

Body composition of 215 laboratory-raised old-field mice was examined at weekly intervals from 0—6 weeks of age. Water (H_2O) and dry weight biomass (*DWB*) in live weight biomass (*LWB*) were estimated by freeze drying the specimens. Proportions of ether-extractable fat (*FAT*) and lean dry biomass (*LDB*) in *DWB* were determined using a Goldfisch Fat Extractor. Amount of ash (*ASH*) in live animals ($N=176$) was estimated from samples of dry weight biomass ashed in a muffle furnace at 450°C for 4 hours.

Coloric determination of *FAT* and *LDB* were made with a Parr Adiabiatic Oxygen Bomb Calorimeter. Corrections were made for nitric acid. Twenty-one samples of *LDB* (0.5—1.0 g), two to four for each age class, were bombed. The zero age class consisted of composite samples from two or three mice because of the small amount of *LDB* per individual. Weight of ash-free *LDB* (*AFLDB*) was calculated from *ASH* left in the bombing pan. *FAT* was combined into seven composite samples, one for each age class, dissolved in petroleum ether, and stored in a freezer. The ether was evaporated prior to bombing. One to six subsamples (0.2—0.3 g) were bombed for each age class; only one sample was available for new born mice.

Total calories in each mouse were determined from age-specific caloric values for *FAT* and size-specific values for *LDB*. Calories in *LWB* were estimated by multiplying the amount of both *FAT* and *LDB* in each mouse by the appropriate caloric density values and summing the two values. Total calories in each mouse were then divided by the *DWB*, ash-free *DWB* (*AFDWB*) and *LWB* to estimate caloric density of each component.

III. RESULTS

1. Caloric Value of FAT

Caloric density of *FAT* ranged from 8.77 to 9.21 kcal/g with an average value for the seven age classes of 9.07 kcal/g (Table 1). Caloric value

Table 1

Mean values (2 *SE* in parentheses) for body composition and caloric density of *Peromyscus polionotus* summarized by age class.

Age, days	Body Composition						*FAT*[1]		*LDB*		*AFLDB*	
	N[2]	*LWB*	*DWB*	*LDB*	*FAT*	*ASH*	*N*	kcal/g	*N*	kcal/g	*N*	kcal/g
0	44,22	1.59 (0.07)	0.28 (0.02)	0.25 (0.01)	0.02 (0.00)	0.03 (0.00)	1	8.77	3	4.74 (0.03)	2	5.40 (0.06)
7	26,20	3.39 (0.24)	0.76 (0.07)	0.62 (0.06)	0.14 (0.02)	0.08 (0.01)	3	9.00	3	4.76 (0.05)	2	5.34 (0.14)
14	35,29	5.32 (0.20)	1.52 (0.09)	1.12 (0.05)	0.40 (0.05)	0.14 (0.01)	4	9.05	3	4.62 (0.06)	2	5.29 (0.16)
21	30,28	6.67 (0.37)	2.05 (0.12)	1.54 (0.10)	0.51 (0.06)	0.25 (0.03)	4	9.13	3	4.49 (0.01)	3	5.27 (0.09)
28	26,24	8.47 (0.42)	2.61 (0.20)	1.97 (0.10)	0.64 (0.12)	0.29 (0.03)	4	9.17	3	4.58 (0.05)	2	5.31 (0.02)
35	21,21	9.62 (0.50)	2.96 (0.22)	2.24 (0.11)	0.72 (0.13)	0.31 (0.03)	4	9.21	2	4.65 (0.12)	3	5.39 (0.06)
42	33,32	11.43 (0.45)	4.05 (0.23)	2.66 (0.11)	1.38 (0.18)	0.42 (0.03)	6	9.19	4	4.62 (0.03)	2	5.36 (0.14)
Avg.	—	—	—	—	—	—	7	9.07 (0.06)	7	4.64 (0.03)	7	5.34 (0.04)

[1] Since *FAT* was a mixture from several animals, the standard errors are not given. Standard errors of the bombing technique using three samples of *FAT* from the same mixture ranged from 0.01—0.77 and averaged 0.02 kcal/g *FAT*.

[2] Second value of *N* refers to sample size for *ASH* values.

of *FAT* increased with age (kcal/g *FAT* = 8.88 + 0.01 DAYS, $r = 0.90$, df = 5, $P<0.01$). The older animals were probably approaching a constant caloric density (Table 1). Average caloric value of *FAT* for sub-adult and adult size animals (21-42 days, Table 1) was 9.18 kcal/g (2 SE=0.02).

Amount of *FAT* and therefore total calories of *FAT*, estimated from the age-specific caloric values, increased with age (Tables 1 & 2). With respect to size, the amount and calories of *FAT* increased from 1—2 g to 6—7 g mice, with a drop in the 7—8 g mice and subsequent increase to 13—14 g (Table 2). This drop in total calories was most likely due to weaning at 21 days (average 6—7 g) and the subsequent change in diet. The relationship between total calories of *FAT* and *LWB* was characterized by kcal *FAT* = − 2.521 + 1.162 g *LWB* ($r = 0.88$, df = 213, $P<0.01$).

2. Caloric Value of LDB

Caloric density of *LDB* ranged from 4.49 to 4.76 kcal/g with a decrease from 0 to 21 days and a subsequent increase to 42 days (Table 1). These changes with size can be characterized by two linear regression equations. The equation for 1—6 g was

$$Y = 4.842 + 0.046X \quad (1)$$
$$(r = 0.70, \text{df} = 9, P<0.05)$$

and for 6—14 g

$$Y = 4.389 + 0.023X \quad (2)$$
$$(r = 0.62, \text{df} = 8, 0.06>P>0.05)$$

where Y equals kcal/g *LDB* and X equals g *LWB*.

Caloric density of *AFLDB* ranged from 5.27 to 5.40 kcal/g and was more constant than the caloric density of *LDB* (Table 1). No obvious changes occurred with age and the mean value across age classes using the average density for each age was 5.34 kcal/g (2 SE=0.04).

Total calories of *LDB* in each animal was estimated using the weight of the animal multiplied by the appropriate average caloric density for each 1 g weight class (*e.g.*, caloric density at 1.5 g was the average for the 1—2 g size class). Average caloric density for the five size classes from 1 to 6 g was estimated from Eq. 1 and the eight classes from 6—14 g from Eq. 2.

Amount and calories of *LDB* increased with age and size (Tables 1 & 2). Total calories of *LDB* were correlated to *LWB* and the relationship was described by kcal *LDB* = − 0.725 + 1.145 g *LWB* ($r = 0.99$, df = 213, $P<0.01$).

3. Caloric Value of DWB

Total calories in a mouse increased from 1.37 kcal for 1—2 g mice to 30.0 kcal for 13—14 g mice (Table 2). This increase was characterized

Table 2

Mean values (2 *SE* in parentheses) of age, body composition, calories and caloric density of *Peromyscus polionotus* summarized by weight class.

Wt., g	N[1]	AGE, days	*LWB*	*DWB*	*LDB*	*FAT*	*ASH*	Calories kcal			kcal/g		
								FAT	*LDB*	*TOTAL*	*DWB*	*AFDWB*	*LWB*
1-2	42, 20	0.00 (0.00)	1.55 (0.04)	0.27 (0.01)	0.24 (0.01)	0.02 (0.00)	0.03 (0.00)	0.20 (0.02)	1.17 (0.03)	1.37 (0.05)	5.13 (0.04)	5.74 (0.08)	0.89 (0.01)
2-3	10, 8	5.60 (1.87)	2.57 (0.15)	0.52 (0.04)	0.45 (0.03)	0.07 (0.02)	0.06 (0.01)	0.65 (0.18)	2.15 (0.13)	2.79 (0.26)	5.32 (0.16)	6.04 (0.25)	1.09 (0.06)
3-4	10, 9	7.00 (0.00)	3.59 (0.15)	0.81 (0.05)	0.67 (0.05)	0.14 (0.02)	0.09 (0.01)	1.25 (0.14)	3.14 (0.24)	4.39 (0.21)	5.43 (0.09)	6.05 (0.11)	1.22 (0.02)
4-5	17, 15	12.35 (1.91)	4.49 (0.16)	1.17 (0.07)	0.92 (0.06)	0.25 (0.02)	0.11 (0.01)	2.29 (0.22)	4.25 (0.29)	6.54 (0.39)	5.59 (0.08)	6.18 (0.09)	1.45 (0.04)
5-6	30, 25	15.87 (1.15)	5.61 (0.10)	1.66 (0.05)	1.21 (0.03)	0.46 (0.04)	0.17 (0.01)	4.16 (0.35)	5.54 (0.15)	9.70 (0.40)	5.82 (0.08)	6.46 (0.11)	1.72 (0.05)
6-7	15, 14	20.07 (1.27)	6.55 (0.13)	2.03 (0.06)	1.48 (0.07)	0.55 (0.08)	0.24 (0.02)	5.03 (0.69)	6.73 (0.33)	11.77 (0.52)	5.78 (0.16)	6.54 (0.21)	1.80 (0.08)
7-8	19, 18	25.79 (1.87)	7.57 (0.14)	2.23 (0.11)	1.79 (0.06)	0.43 (0.03)	0.28 (0.04)	3.97 (0.72)	8.18 (0.28)	12.15 (0.82)	5.43 (0.13)	6.23 (0.20)	1.60 (0.09)
8-9	14, 14	32.00 (2.42)	8.45 (0.14)	2.55 (0.08)	1.99 (0.04)	0.56 (0.07)	0.28 (0.02)	5.14 (0.63)	9.13 (0.19)	14.27 (0.65)	5.59 (0.11)	6.28 (0.13)	1.69 (0.07)
9-10	14, 13	33.50 (3.00)	9.59 (0.15)	3.09 (0.11)	2.20 (0.04)	0.90 (0.12)	0.33 (0.03)	8.23 (1.12)	10.14 (0.16)	18.37 (1.07)	5.93 (0.13)	6.65 (0.17)	1.92 (0.11)
10-11	20, 20	37.10 (2.71)	10.49 (0.13)	3.47 (0.14)	2.49 (0.09)	0.98 (0.13)	0.36 (0.02)	9.00 (1.21)	11.55 (0.40)	20.55 (1.19)	5.91 (0.13)	6.60 (0.15)	1.96 (0.11)
11-12	10, 9	40.60 (1.87)	11.55 (0.19)	4.13 (0.28)	2.65 (0.13)	1.48 (0.27)	0.44 (0.04)	13.59 (2.49)	12.38 (0.60)	25.98 (2.48)	6.26 (0.20)	6.96 (0.19)	2.25 (0.22)
12-13	6, 6	42.00 (0.00)	12.46 (0.22)	4.56 (0.32)	2.88 (0.14)	1.67 (0.34)	0.45 (0.04)	15.38 (3.10)	13.52 (0.67)	28.90 (2.95)	6.33 (0.24)	7.02 (0.17)	2.32 (0.24)
13-14	5, 5	42.00 (0.00)	13.42 (0.26)	4.75 (0.56)	3.03 (0.11)	1.71 (0.61)	0.51 (0.07)	15.74 (5.64)	14.26 (0.50)	30.00 (5.30)	6.27 (0.39)	7.04 (0.36)	2.23 (0.37)

[1] Second value of N refers to sample size for *ASH* values.

by kcal TOTAL = − 3.246 +2.308 g *LWB* (r = 0.97, df = 213, P<0.01).

Converting total calories to kcal/g *DWB*, the change with size ranged from 5.13 kcal/g for 1—2 g mice to 6.27—6.33 kcal/g for 12—14 g mice, while the *AFDWB* values ranged from 5.74 kcal/g at 1—2 g to 7.02—7.04 kcal/g at 12—14 g mice (Table 2). Caloric density of *DWB* and *AFDWB* was highly correlated to g *LWB* (kcal/g *DWB* = 5.077 + 0.088 g *LWB*, r = 0.74, df = 213, P<0.01; kcal/g *AFDWB* = 5.719 + 0.095 g *LWB*, r = = 0.70, df = 174, P<0.01). Caloric density of *DWB* was also correlated to the per cent *AFLDB* in *DWB*, per cent *FAT* in *DWB* and per cent *ASH* in *DWB* (kcal/g *DWB* = 8.512−0.043 % *AFLDB*, r = 0.96, df =

Table 3

Slope (b), intercept (a), correlation coefficient (r) and degrees of freedom (df) for the relationship between kcal/g *LWB* (y-axis) and g *LWB* (x-axis) in *Peromyscus polionotus* using different ranges of *LWB*. The relationship was also calculated with large values of the fat index (*FI* = g FAT/g *LDB*) excluded for 7-14 g mice.

Range of weight, g	$a \pm 2$ SE	$b \pm 2$ SE	r	df
1-14	0.8208±0.0598	0.1180±0.0084	0.89**	213
1-7	0.5842±0.0376	0.1940±0.0089	0.97**	125
7-14	0.5910±0.2929	0.1339±0.0294	0.70**	86
7-11	0.6159±0.3659	0.1300±0.0401	0.63**	65
11-14 [1]			0.02	19
7-14, *FI*<0.50	1.0092±0.2468	0.0816±0.0260	0.61**	68
7-14, *FI*<0.40	1.1347±0.2801	0.0621±0.0309	0.49**	50
7-14, *FI*<0.30	1.2878±0.3209	0.0354±0.0370	0.33*	30

[1] r value not significant, therefore, intercept and slope not given; mean value of caloric density for 11-14 g mice was 2.24 kcal/g *LWB* (2SE = 0.16).
* $P \cong 0.07$; ** P<0.01.

= 174, P<0.01; kcal/g *DWB* = 4.708 + 0.042 % *FAT* in *DWB*, r =0.98, df = 213, P<0.01; kcal/g *DWB* = 6.041−0.033 % *ASH* in *DWB*, r = 0.15, df = 174, P<0.05).

4. Caloric Value of LWB

Caloric density of *LWB* increased with age and size (Table 2). The range in caloric values was from 0.89 kcal/g at 1—2 g to 2.23—2.32 kcal/g at 11—14 g. Changes in caloric density of *LWB* with size followed a similar pattern of change as *DWB* with size (Table 2).

The relationship between kcal/g *LWB* and g *LWB* was significant for 1—14 g mice (Table 3). Since there was an apparent change in the slope of kcal/g *LWB* versus g *LWB* near both 7 g and 11 g (Table 2), correlation and regression analyses were performed on 1—7 g, 7—14 g, 7—

—11 g and 11—14 g weight ranges (Table 3). All correlations were significant except for the relationship between kcal/g *LWB* and g *LWB* for 11—14 g mice. Changes in the relationship between kcal/g *LWB* and g *LWB* for the 7—14 g mice were also examined with the fatter animals deleted (Table 3).

The relationships between the caloric density of *LWB* and the different components of *LWB* were calculated. Caloric density of *LWB* was correlated to per cent H_2O, per cent *AFLDB*, per cent *FAT* and per cent *ASH*. The relationships were kcal/g $LWB = 6.725 - 0.071$ % H_2O in *LWB*, $r = 0.99$, df = 213, $P < 0.01$; kcal/g $LWB = -0.370 + 0.110$ % *AFLDB* in *LWB*, $r = 0.62$, df = 174, $P < 0.01$; kcal/g $LWB = 0.822 + 0.113$ % *FAT* in *LWB*, $r = 0.97$, df = 213, $P < 0.01$; and kcal/g $LWB = 0.473 + 0.380$ % *ASH* in *LWB*, $r = 0.70$, df = 174, $P < 0.01$.

DISCUSSION

1. Caloric Value of FAT

In ecological energetics studies, the caloric value of *DWB* is usually measured, and therefore, only infrequently has the caloric density of *FAT* been examined. Odum *et al.* (1965) reported a range of 8.7—9.2 kcal/g for extractable fat in a variety of birds and assumed a value of 9.0 kcal/g *FAT* to be a useful estimate for the caloric density of birds. For mammals, caloric values of *FAT* which have been determined are 9.1—9.3 kcal/g for yellow-necked field mice (Sawicka-Kapusta, 1968), 9.0 for baby *Mus* (Barrett, 1969), 9.4 for two species of bats (Baker *et al.*, 1968; Ewing *et al.*, 1970) and 8.9—9.1 for yellow-necked mice and bank vole (Pucek, 1973). To convert amount of *FAT* into calories, Brisbin (1970) assumed 9.0 kcal/g from Odum *et al.* (1965) whereas Caldwell & Connell (1968) assumed a value of 9.5 kcal/g. Average caloric values of *FAT* (9.1 kcal/g for all ages and 9.2 kcal/g for older mice) were not greatly different from the 9.0 kcal/g and use of 9.0 kcal/g rather than our age-specific values (Table 1) would have caused less than a 3% over- or under-estimate of the total calories of *FAT* in any of the mice. The value of 9.5 kcal/g is too large for use with rodents but the use of 9.1 kcal/g for ecological energetics studies would seem reasonable.

Obviously, changes in caloric value of *FAT* were related to differences in the combinations of ether extractable materials, fats as well as other organic compounds. A major difference in the fat of young and old rats or mice is a greater proportion of short-chained fatty acids in young animals which is most likely the result of milk-feeding (reviews by Jeanrenaud, 1965; Gellhorn & Benjamin, 1965). Caloric density of fatty acids increase with length (from 8.5 kcal/g for capric acid to 9.5 kcal/g for stearic acid; values calculated from H o d g m a n, 1962). The presence of a large proportion of short-chained fatty acids would reduce the caloric density of fat in young animals and this was consistent with our results.

2. Caloric Value of LDB

Caloric density of *LDB* in the old-field mouse (Table 1) was similar to values reported for *Mus musculus*, 4.5 kcal/g, (B r i s b i n, 1970) and for 20 species of birds, average value of 4.7 kcal/g (O d u m *et al.*, 1965). The change in caloric value of *LDB* with age was due to relative changes in composition of the different components in *LDB*, with the change in *ASH* relative to the non-*ASH* portion of *LDB* the most important. The significant relationship between kcal/g *LDB* (*Y*) and the average per cent *ASH* of *LDB* (*X*) was

$$Y = 5.443 - 0.062\,X \quad (r = 0.94,\ \text{df} = 5,\ P<0.01). \qquad (3)$$

In addition, the caloric density of *AFLDB* ranged from 5.27 to 5.40 kcal/g (Table 1) and these values were only slightly lower than the expected value of *AFLDB* (5.44 kcal/g) from Eq. 3.

3. Caloric Value of DWB

Caloric density of *DWB* and *AFDWB* has been reported for several wild caught rodents (G o l l e y, 1960, 1969—70; G ó r e c k i, 1965; F l e h a r t y *et al.*, 1973). The caloric density of *DWB* in field caught adult rodents is lower (range 4.6—6.0 kcal/g *DWB*) than the values of laboratory-raised adult rodents (range 5.5—6.3 kcal/g *DWB;* Table 2, M y r c h a & W a l k o w a, 1968; S a w i c k a - K a p u s t a, 1970). Caloric density of *AFDWB* shows the same trends. Higher caloric values of *DWB* and *AFDWB* of adult mice under laboratory conditions are the result of the increased *FAT* content of rodents maintained in the laboratory (C a l d w e l l & C o n n e l l, 1968; B r i s b i n, 1970; S a w i c k a - K a p u s t a, 1970). The seasonal variation in caloric values of wild caught rodents (G ó r e c k i, 1965; G o l l e y, 1969—70) is also related to proportion of *FAT* in the mice with the higher caloric values occurring during months or seasons when mice had the greatest proportion of *FAT*.

Two other species of rodents (*Mus musculus* and *Microtus arvalis*) have been examined for caloric density changes during postnatal growth (M y r c h a & W a l k o w a, 1968; S a w i c k a - K a p u s t a, 1970). Both of these species show the trend of increase, decrease and subsequent increase in caloric density of *DWB* that was characteristic of the old-field mouse (Table 2). These changes of caloric density during growth in the common vole and old-field mouse were also correlated to changes in *FAT* content (correlation coefficient (r) for kcal/g *DWB* and % *FAT* in *DWB* was 0.98 ($P<0.01$) for old-field mice and 0.77 ($P<0.05$) for common vole using average values for seven age classes calculated from Tables 1 and 4 in Sawicka-Kapusta (1970). The per cent of *ASH* in *DWB* was weakly correlated to the caloric density of *DWB* ($r = 0.15$) in the old-field mouse. The relationship between kcal/g *DWB* and % *ASH* in *DWB* using average values for seven age classes of the common vole was nonsignificant ($r = 0.66$, $0.10>P>0.05$) although the general trend was one of increasing caloric density with decreasing proportion of *ASH*. From these results as well as the comparison of the relative amounts of *FAT* and *ASH* in *DWB* it is obvious that *FAT* also has the major effect of changing the caloric value of *DWB* of rodents during growth.

4. Caloric Value of LWB

Caloric density of the *LWB* of house mice increased with age (size) from 0.9 kcal/g *LWB* in day-old mice to over 2.0 kcal/g in large adults (Myrcha & Walkowa, 1968; Brisbin, 1970). A similar trend and range of values occurred in the old-field mice (Table 2). Using data on body composition and caloric density of *DWB* in the common vole (Sawicka-Kapusta, 1970), we calculated the caloric density of *LWB* for this rodent. Again these values show close agreement to the changes in the house mice and old-field mice during postnatal growth although the actual weights or ages at which the major changes occur vary between the three species.

Since these changes in *LWB* occur, the use of a single average caloric value introduces error into the estimation of total calories in different age classes, especially the very young individuals. In addition, the lack of knowledge concerning the age of the mice under field conditions makes it impractical to use age-specific caloric values rather than size-specific values. The most useful way to relate caloric density of *LWB* to size is through the use of one or more predictive equations rather than a limited number of size-specific constants. Brisbin (1970) used two equations for prediction of caloric density of the LWB of house mice raised under laboratory conditions. Two equations, one for 1—7 g mice and another for 7—14 g mice, rather than a single equation are needed to estimate the caloric density of *LWB* in old-field mice raised in the laboratory (Table 3). The number of equations needed is dependent upon the relative changes in *FAT*, H_2O, *ASH* and *AFLDB* components during growth and weaning.

The proportions of the four major gross body components of *LWB* (H_2O, *FAT*, *ASH* and *AFLDB*) change with age and size (Tables 1 & 2).

Correlations between kcal/g *LWB* and these four components were all significant (see Section 4 in RESULTS). However, the per cent *ASH* makes up such a minor part of *LWB* and changes so little across age (size) that it has relatively little effect on the change in *LWB* with age (size). H_2O which decreases relative to the *LDB* and *FAT* which increases relative to the *LDB* during growth has the same general effect of increasing the caloric density of *LWB* in older mice relative to the caloric density of young mice. The increase in kcal/g *LWB* then becomes extremely pronounced when the adult mice become obese under the *ad lib.* food regime.

5. Caloric Value of Field and Laboratory Micè

The caloric density of adult *P. polionotus* (Table 2 & 2.5 kcal/g *LWB* estimated from Scarth *et al.*, 1973) was similar to house mice (2.25 kcal/g *LWB*, Myrcha & Walkowa, 1968; 2.14 kcal/g *LWB*, Brisbin, 1970) and the common vole (2.31 kcal/g *LWB* calculated from Sawicka-Kapusta, 1970) but was much greater than the 1.4—1.6 kcal/g *LWB* of field caught adult rodents (Golley, 1960; Górecki, 1965; Fleharty *et al.*, 1973). In addition, the average fat index (*FI* = g *FAT*/g *LDB*) of adult field caught mice maintained in the laboratory for 5—20 days was double that of field caught animals not held in the laboratory (Caldwell & Connell, 1968). Therefore, equations were calculated for the 7—14 g mice in which animals with *FI* greater than 0.30, 0.40 or 0.50 were eliminated (Table 3). Caloric density of *LWB* in different sized mice was estimated using equations from Table 3 as well as data from Caldwell & Connell (1968) for comparison of laboratory and field caught mice. Caloric values of *LWB* in 7—14 g mice with *FI* less than 0.40 were 1.5—1.8 kcal/g. These values were similar to the caloric value (average 1.7, range 1.5—1.9) for adult old-field mice caught by Caldwell & Connell (1968) calculated from the values of 9.1 kcal/g *FAT*, 4.6 kcal/g *LDB* and 69% water.

Extrapolation of laboratory data to field energetics studies has always been questionable since the laboratory conditions are much less rigorous than field conditions. Data from laboratory-raised and field-caught old--field mice indicate that extrapolation from the laboratory to the field would cause an overestimation of caloric values. Examination of Table 2 & Myrcha & Walkowa (1968) and Brisbin (1970) make apparent that the use of a single caloric value for all sizes of mice would also cause an overestimation of calories in the very young mice. From the estimated caloric density of field-caught mice (Golley, 1960; Górecki, 1965; Fleharty *et al.*, 1973) it is obvious that predictive equations would also vary seasonally dependent upon the relative conditions of the mice. Therefore, a series of field-caught mice over a range of sizes and seasons should be used to develop predictive equations for field conditions.

Finally, caloric density of small mammals could be estimated by analyzing relative proportions of body components and using caloric constants for these body components rather than by bombing tissue samples. We suggest that the caloric densities of 9.1 kcal/g *FAT*, 5.3 kcal/g *AFLDB* and 4.6 kcal/g *LDB* be used to estimate *LWB* caloric values for field studies. Caloric values of 8.9—9.0 kcal/g *FAT* and 4.7 kcal/g *LDB* could be used for young mice but considering the proportion of water in these mice differences are minor. The values of 9.1 kcal/g *FAT* and 5.3 kcal/g *AFLDB* were utilized to estimate *LWB* caloric density of the common vole using body components from Sawicka-Kapusta (1970). The comparison of these *LWB* caloric values to the *LWB* caloric density calculated from *DWB* caloric data given by Sawicka-Kapusta (1970) was quite good ($r = 0.99$, df $= 5$, $P < 0.01$) with the slope of the relationship not different from one. In addition, caloric values for the cotton rat (*Sigmodon hispidus* Say & Ord) during January, April, July and October from Golley (1969—70) were similar to those estimated from Briese & Smith (MS) using *FAT* and *AFLDB* constants. These comparisons support the use of caloric constants.

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WARTOŚĆ KALORYCZNA *PEROMYSCUS POLIONOTUS* (WAGNER, 1843) W ROZWOJU POSTNATALNYM

Streszczenie

Badano skład ciała 215 wyhodowanych w laboratorium *Peromyscus polionotus* w tygodniowych odstępach czasu, w wieku od 0—42 dni. Wodę i suchą biomasę (*DWB*) w świeżej biomasie oznaczono za pomocą wymarzania. Zawartość wyekstrahowanego za pomocą eteru tłuszczu (*FAT*) i suchej biomasy beztłuszczowej (*LDB*) w *DWB* oznaczono przy użyciu ekstraktora Goldfischa. Ciężar popiołu z każdej myszy oznaczono spalając próbki w piecu muflowym. Wartość kaloryczną tłuszczu i *LDB* oznaczono za pomocą bomby kalorymetrycznej.

Wartość kaloryczna tłuszczu wahała się od 8,77—9,21 kcal/g, z średnią dla klas wiekowych — 9,07 kcal/g (Tabela 1). Wartość ta wzrastała z wiekiem od 0—42 dnia (kcal *FAT* + 8,88 + 0,01 dni, $r = 0{,}90$, df = 5, $P<0{,}01$). Kaloryczność tłuszczu u każdej myszy, obliczana na podstawie jego zawartości i specyficznej dla danego wieku kaloryczności, wzrastała z wiekiem i wielkością ciała (Tabela 1 i 2).

Wartość kaloryczna *LDB* wahała się od 4,49 do 4,76 kcal/g. Kaloryczność *LDB* u każdej myszy (Tabela 2) oznaczono jako wartości specyficzne dla danych rozmiarów ciała, dla klas różniących się o 1 g (tzn. 1—2 g, 2—3 itd.). Wartości specyficzne dla danych rozmiarów ciała ułożono w postaci dwóch równań, pierwszego dla myszy o ciężarze ciała 1—6 g (kcal/g *LDB* = 4,842 + 0,046 g *LWB*, $r = 0{,}70$, df = 9, $P<0{,}05$) i drugiego dla myszy o ciężarze 6—14 g (kcal/g *LDB* = 4,389 + 0,023 g *LWB*, $r=0{,}62$, df=8, $0{,}06>P>0{,}05$). Wartość kaloryczna wolnej od popiołu biomasy (*AFLDB*) nie zmieniała się z wiekiem, średnia wartość wynosiła 5,34.

Całkowitą kaloryczność każdej myszy obliczano na podstawie kaloryczności tłuszczu i *LDB* (Tabela 2). Używając wartości klaryczności całkowitej, oznaczono wartość kaloryczną *DWB* i *LWB*. Wartość kaloryczna *DWB* wzrastała od 5,13 kcal/g dla myszy o ciężarze ciała 1—2 do 6,27—6,33 kcal/g dla myszy o ciężarze 12—14 g (Tabela 2). Wartość kaloryczna *DWB* była wysoko skorelowana z *LWB* (kcal/g *DWB*=5,077+0,088 g *LWB*, $r=0{,}74$, df=213, $P<0{,}01$).

Wartość kaloryczna *LWB* wzrastała także z wiekiem i wielkością ciała (Tabela 2) i wahała się od 0,89 kcal/g *LWB* przy 1—2 g do 2,23—2,32 kcal/g *LWB* przy 11—14 g. Współzależność między kcal/g i g *LWB* (Tabela 3) została scharakteryzowana za pomocą dwu równań, jednego dla 1—7 gramowych myszy (kcal/g *LWB*=0,584+ +0,194 g *LWB*, $r=0{,}97$, df=125, $P<0{,}01$) i drugiego dla 7—14 gramowych myszy (kcal/g *LWB*=0,591+0,134 g *LWB*, $r=0{,}70$, df=86, $P<0{,}01$).

Zawartość tłuszczu u myszy wyrosłych w warunkach laboratoryjnych jest wyższa niż u złowionych w terenie i powoduje wzrost ich wartości kalorycznej w stosunku do zwierząt z terenu. Ponadto, ponieważ zwierzęta terenowe zmieniają się sezonowo, nasuwa to wniosek o konieczności serii równań, ustalających zależność między wartością kaloryczną a wielkością ciała w różnych sezonach, jeżeli pożądany jest wysoki stopień dokładności.

Autorzy sugerują, że dla oznaczenia kaloryczności składu ciała należy stosować raczej stałych kalorycznych: 9,1 kcal/g *FAT*, 5,3 kcal/g *AFLDB*, niż spalanych próbek tkanek. Poza tym dokładność oznaczeń wartości kalorycznych u małych ssaków byłaby większa gdyby określano zawartość popiołu i posługiwano się wzrostem *AFLDB* zamiast *LDB*.