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Animal longevity and protein turnover rate

THE life spans of various mammalian species differ but the biochemical mechanism of this regularity is unknown. In our opinion there is a sufficient amount of experimental data to solve this problem. We refer to the data presented in twelve investigations by different authors collated into one table (Table 1), and the data of the two works collated in another (Table 2)[1]. In these, the data on the protein plasma turnover for various species of mammals is presented. We have added a column on the maximum life span of the species[2] into each table.

Table 1 shows that the highest rate of protein turnover is observed in the rat, it is lower in the dog, and still lower in human beings. Table 2 shows that the small animals, such as mice, guinea pigs or rabbits, have the highest rate of turnover, and the turnover is lower for dogs, and still lower for cows, monkeys and human beings.

In terms of a life span there is a negative correlation between the longevity of animals and their protein turnover rate. The existence of such a regularity has attracted no attention so far. The protein turnover rate, however, does characterise the intensity of protein synthesis, and this in turn, depends on the intensity of DNA activity.

TABLE 2 Turnover of homologous proteins of various species labelled with ^{131}I (ref. 1, column reference indicates 262 and 263).

Species	Albumins Time interval (d)	Albumins Halflife (d)	γ globulin Time interval (d)	γ globulin Halflife (d)	Maximum lifespan (yr)
Human	7–28	15.0	4–21	13.1	110–115
Cow	2–30	20.7	6–27	21.2	20*
Monkey			4–24	6.6	30
Dog	7–28	8.2	7–17	8.0	18
Rabbit	4–22	5.7	4–21	4.6	15
Guinea pig			4–13	5.4	7
Mouse	3–7	1.2	1–5	1.9	3
Rabbit		4.5			5

* These data apply to ruminants and herbivores in general.

TABLE 1 Turnover of plasma proteins of various species of mammals.

Protein	Species	Active matter	Method*	Half-life (d)	Reference to literature†	Maximum life-span (yr)
General plasma protein	Rat	^{35}S-DL-methionine	D	2.6	207	
		^{35}S-DL-methionone	D	4.4	222	5
		DL-serine-3	H	3.0	232	
		Rhodospirillum-rubrum-^{14}C	H	3.0	198	
		^{35}S-L-methionine	D	3.5	259	
	Dog	^{35}S-DL-methionine	D	5.2–6.4	115	18
		^{15}N-DL-lysine	H	5.4	230	
		DL-lysine-6	H	5.0	208	
		^{35}S-DL-methionine	H	5.0	115	
		^{35}S-DL-methionine	D	6.6	260	
	Human	^{35}S-DL-methionine	D	9.2	115	110–115
	Human	^{15}N-glycine	D	10.0	261	
	Human (male)	^{15}N-glycine	D	7.0	240	
	Human (female)	^{15}N-glycine	D	9.0	240	
Albumin	Rat	^{35}S-L-methionine	D	5.0	259	
	Dog	DL-lysine-6	H	6.9	208	
	Human (male)	^{15}N-glycine	D	20	240	
	Human (female)	^{15}N-glycine	D	20	240	
Globulin	Rat	^{35}S-L-methionine	D	3.0	259	
	Dog	DL-lysine-6	H	3.3	207	
α_1 globulin	Rat	^{35}S-L-methionine	D	3.0	259	
α_2 globulin	Rat	^{35}S-L-methionine	D	2.0	259	
β globulin	Rat	^{35}S-L-methionine	D	3.0	259	
γ globulin	Rat	^{35}S-L-methionine	D	3.2	259	
Globulins $\beta + \gamma$	Human (male)	^{15}N-glycine	D	12	240	
γ globulin	Human (male)	^{15}N-glycine	D	19	240	
Globulins $\beta + \gamma$	Human (female)	^{15}N-glycine	D	9.0	240	
γ globulin	Human (female)	^{15}N-glycine	D	18	240	
Fibrinogen	Dog	^{35}S	D, CP	4.2	227	
Fibrinogen	Human	^{35}S	D	8.1	227	

* "D", is a direct method used to determine the isotope concentration in protein at some intervals after injection of the labelled material. "H" is (Heveshi's method) introduction of the labelled protein to the recipient animal with subsequent measurement. "CP" is the constant fund method. Half-life span measured by the different methods is approximately the same.
† Column reference indices Sam Tarver[1].

I. M. SPECTOR

Institute of Traumatology
3, Gorky St.,
Kazan, U.S.S.R.

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