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Received August 7, 1961 P.S.E.B.M., 1961, v108

Antiproteolytic Power of Blood and Body Weight in the Albino Rat. (27026)

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The manifest antiprotease power (AP) of plasma as measured by its ability to inhibit tryptic digestion depends not only on the amount of antiproteases present but also on the amount of circulating proteases, on the physico-chemical state of the blood, and on the different affinities of the various inhibitor substances for trypsin.

This is a report on plasma AP of 143 albino rats (71 males and 72 females).

Method. 20 cmm of tail blood was withdrawn into a haemoglobin pipette and expelled into 10 ml of Sorensen's Phosphate Buffer pH 7.1. At the same time some blood was withdrawn into a heparinized capillary tube for determination of the packed cell volume (PCV). The blood-buffer mixture was immediately centrifuged for 15 minutes at 3,000 r.p.m. and the supernatant fluid used for antiprotease assay.

The assay was based on the determination of the optical density produced by the residual protein after incubation with protease, both with and without addition of plasma. The reaction mixture consisted of 1 mg Casein, 5 units Tryptar Armour (Lyophilized Crystalline Trypsin) and 0.001 ml plasma, made up to a total volume of 4 ml with Sorensen's Phosphate Buffer pH 7.1. The mixture was incubated for 15 minutes at 37.5°. The results are expressed in mg Casein saved from tryptic digestion by 1 ml plasma, this being the form of expression involving the least number of assumptions.

Results. Results are shown in Table 1. They were analysed from the point of view of sex, age, weight and PCV. Irrespective of sex, animals of the same weight show the same average plasma AP values. The PCV of these rats is low at birth and rises rapidly to reach a plateau of about 44% at the age of 8 weeks. The rising PCV correlates with the rising AP but thereafter the AP continues to rise while the PCV remains constant. It would therefore seem that concomitant rises during the first 8 weeks are not causally related. Plasma AP rises with age but the increase follows weight and not age.

When the weights of the animals regardless of sex, age or PCV are plotted against the AP, the data fit the quadratic equation: $AP = 252.7922 + 2.7083\ (G) - 0.004548\ (G)^2$. This is a statistically significant fit ($F = 10.4$; $n_1 = 1$, $n_2 = 136$; $P = 0.002$). Over the range of weights observed the data agree with the hypothesis that the change in antiproteolytic power is related to weight by a quadratic equation. It follows that there will also be a correlation with body surface.

Discussion. Plasma AP results from the actions of a number of inhibitor substances each having different affinities for at least 5 distinct proteases; (1,2,3,4,5). Changes in the plasma AP occur in response to a variety of distinct though not necessarily unrelated processes including absorption into the blood of pancreatic trypsin and antitrypsin, blood clot-

* This investigation was carried out under the aegis of the N.Z. Medical Research Council. Mr. George F. Spears of the Otago Medical School did the statistical work and Miss Maureen Kennedy was technical assistant.

TABLE I.

MALES					FEMALES				
No.	PCV	Age	Wt G	AP Mg. Casein Ml. Plasma	No.	PCV	Age	Wt G	AP Mg. Casein Ml. Plasma
1	28	6 hr	3	222	1	27	1 hr	2½	233
2	26	24 “	4	270	2	29	6 “	3	240
3	22	24 “	5	205	* 3	142/4	12 “	20/4	309
4	22	24 “	5	205	4	32	3 days	5	294
* 5	116/4	12 “	20/4	364	* 5	162/5	6 “	30/5	328
6	26	3 days	5	337	6	32	10 “	7½	123
7	23	4 “	8	337	7	26	4 “	8	270
* 8	124/4	5 “	36/4	253	8	31	10 “	12	202
* 9	111/3	14 “	48/3	90	9	38	3 wk	12½	292
10	33	3 wk	16	298	*10	80/2	14 days	30/2	240
11	36	4 “	21	171	11	39	14 “	17	363
12	29	13 days	24	222	*12	90/3	13 “	63/3	324
13	29	3 wk	25	401	13	31	3 wk	25	145
14	31	4 “	34	318	14	37	7 “	37	158
15	46	8 “	38†	155	15	33	6¼ “	39	608
16	34	5 “	40	560	16	36	5 “	40	416
17	49	8 “	43†	686	17	34	6¾ “	45	530
18	35	6¼ “	45	171	18	36	6¼ “	45	312
19	34	6¾ “	54	515	19	33	7 “	48	350
20	47	7½ “	55†	362	20	36	5 “	60	434
21	34	5 “	57	364	21	39	7½ “	62	450
22	46	7½ “	69	444	22	49	7½ “	74	486
23	44	9½ “	79	339	23	39	8 “	80	818
24	47	7½ “	90	509	24	40	8 “	81	278
25	41	8¼ “	95	242	25	42	9½ “	81	362
26	41	10 “	117	379	26	42	8¼ “	83	522
27	44	7½ “	120	819	27	41	8¼ “	93	613
28	45	7½ “	120	627	28	38	7½ “	98	387
29	44	8 “	130	642	29	40	8½ “	105	690
30	42	10 “	130	443	30	43	8 “	111	544
31	43	8½ “	140	550	31	42	9½ “	112	534
32	42	9 “	145	379	32	40	9½ “	114	366
*33	138/3	12 “	486/3	659	33	43	8 “	120	724
34	43	14 “	171	400	34	45	8½ “	125	849
35	46	12 “	185	437	35	41	9 “	125	514
36	45	14 “	190	440	36	42	9 “	135	638
37	48	12 “	195	484	37	37	14 “	145	590
38	49	15 “	250	725	38	44	14 “	152	380
39	46	20 “	285	910	39	46	12 “	160	635
40	45	20 “	285	627	40	42	11½ “	160	562
41	44	22 “	285	500	41	48	12½ “	170	278
42	43	22 “	285	700	42	44	21 “	185	517
43	42	22½ “	289	825	43	44	32 “	185	535
44	46	22 “	290	481	44	47	19 “	187	641
45	47	20 “	290	685	45	44	32½ “	190	446
46	44	21 “	290	481	46	45	21½ “	190	690
47	48	21 “	290	576	47	44	21½ “	195	517
48	46	22½ “	290	611	48	43	32 “	200	280
49	45	22 “	290	672	49	41	25 “	201	610
50	44	20 “	293	696	50	42	34½ “	201	620
51	46	22½ “	293	870	51	44	39½ “	202	798
52	43	22 “	295	749	52	44	22 “	202	553
53	47	19 “	297	962	53	44	? “	210	500
54	45	21½ “	298	436	54	39	26 “	210	647
*55	90/2	22½ “	599/2	723	55	43	22½ “	210	482
56	49	20⅓ “	300	725	56	43	32½ “	210	582
57	46	21 “	300	740	57	45	39½ “	220	845
*58	92/2	23 “	610/2	437	58	45	34½ “	221	545
59	44	19 “	315	892	59	43	22 “	200	473
					60	41	22½ “	205	425
					61	43	22 “	210	491
					62	42	22½ “	216	474

* Pooled sample (more than one animal).
† Starvation due to malocclusion.

ting, fibrinolysis, stress, and changes of adrenal cortical activity not related to stress (6,7,8,9,10,11,12,13,14,15).

Anaphylaxis also produces changes in plasma AP(7,16) and there are also species differences.

For these reasons the interpretation of changes in the manifest AP activity of plasma must be approached with great caution. Underlying the variables which have been mentioned there is a residual or basal AP activity which persists after pancreatectomy(10) and adrenalectomy(11,12). It is this basal AP activity in the plasma of normal rats which seems to be increasing with body weight.

Both in the rabbit and mouse mature animals have been stated to have higher plasma AP than immature ones(10,16) which is consistent with an increase in weight in these species. In our own laboratory, although we have so far found no significant difference in plasma AP of human beings from 2st.3lb to 13st.7lb in weight, average AP value of cord blood was found to be significantly lower(17). It must be remembered that the rat shows a 150-fold increase in body weight over a period of 6 months as compared with a 20-fold increase over a period of 25 years in the human. This may make the detection of biochemical correlates easier in the rat. Some of the inhibitor substances may have physiological actions which are not related to their ability to inhibit proteases, but their presence in the blood constitutes in fact an anabolic potential; as such it must have an influence on the protein and amino acid equilibrium of the blood. In view of the postulated existence of a dynamic equilibrium between circulating and somatic protein(18) plasma AP may therefore be related to total body metabolic activity.

Enzyme activity decreases with the B.M.R. for those enzymes which are directly or indirectly involved in the general metabolic processes(19). The mechanism of this decrease is not understood but a generalized increase in inhibitor activity could in part explain how a decreasing dissipation of heat leads to a decrease of metabolic rate. The rise in plasma AP with increasing body weight in the rat may simply reflect the falling B.M.R.

Summary. In the normal albino rat the antiproteolytic power of the plasma as measured by its ability to inhibit the tryptic digestion of Casein increases significantly with increasing body weight.

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Received August 7, 1961 P.S.E.B.M., 1961, v108