Alterations in Dark Adaptation after the Oral Administration of Creatine and Methionine.

By

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The dark adaptation test, although imperfect in practical application, is yet of value in the selection of aviation candidates. Because during night flying and flying at dusk it necessitates normal or better than normal dark adaptor. In recent years, we have studied certain substances which can affect the ability of dark adaptation¹⁾³⁾⁴⁾ and the present paper limited to creatine and methionine. Our experiments are described and the results given below.

Method: The measurements of dark adaptation were made with a Nagel's adaptometer⁹⁾ The test field subtended an angle of 3 degrees. and 15 degrees superior of the subject's fovea. Both eyes of the subject were exposed to a light of 200 millilamberts for light preadaptation for 15 minutes. During the subsequent darkness at desired time intervals, the subject then rotates the adjusting wheel of the adaptometer with his hand until he just no longer perceives the dim light of the test field (The light intensity of the presentations were determined before the measurements). The wheel-reading represents the just imperceptible light intensity, which is given as the brightness in micromicrolamberts. All values of the threshold were represented by logarithms of the brightness. The source of light for light preadaptation apparatus and the adaptometer was supplied by a constant 100-volts battery.

Results and Discussion: The four normal and healthy male subjects under study were the teaching staffs of our department. Subject Ho. weighed 49, F. 61, P. 54 and Hw. 45 kg., varying in age from 30-52, were all well trained on the adaptometry. The control readings were taken until each subject reached a constant level excepting for the slight unavoidable normal variability found in repeated readings. The average and range of 5 control measurements of each subject are given in Table I.

Then we studied the effect of creatine on dark adaptation. It can

TABLE I.
Average and Range of 5 Control Measurements of Dark
Adaptation for Subjects Ho., F., P. and Hw.

Time in dark (min.)	Log. Intensity ($\mu\mu$ l.)							
	Subject Ho.		Subject F.		Subject P.		Subject Hw.	
	Average	Range	Average	Range	Average	Range	Average	Range
1	6.03	5.99-6.09	5.73	5.67-5.76	6.24	6.16-6.29	5.68	5.67-5.71
2	5.87	5.83-5.88						
3			5.32	5.30-5.35	5.77	5.73-5.79	5.24	5.35-5.48
5	5.52	5.51-5.52	4.94	4.90-4.98	5.69	5.65-5.72	4.94	4.82-5.03
8	4.83	4.77-4.93	4.27	4.25-4.31	5.20	5.14-5.24	4.40	4.35-4.44
10			3.97	3.88-4.01	4.59	4.47-4.64	4.00	3.95-4.06
11	3.96	3.88-4.03						
15	3.27	3.21-3.36	3.10	3.06-3.13	4.17	4.13-4.20	2.97	2.95-3.01
20	2.91	2.87-2.97	3.03	3.01-3.05	3.74	3.70-3.80	2.72	2.65-2.78
25	2.77	2.65-2.84	2.91	2.88-2.92	3.43	3.42-3.45	2.53	2.50-2.55
30	2.56	2.49-2.65	2.79	2.78-2.80	3.30	3.29-3.31	2.46	2.44-2.47
35			2.73	2.69-2.76	3.12	3.12-3.13	2.36	2.36-2.37
40	2.23	2.20-2.33	2.70	2.67-2.73	3.11	3.10-3.11	2.35	2.31-2.37
50	2.18	2.16-2.21						

be noted that after the oral administration of this compound the subjects showed some depression in dark adaptation. The depressed effect varied in different individuals; for instance, with subject P., with an intake of 5 gm. of creatine showed nearly no effect upon the ability of dark adaptation and only a tendency to produce a slight elevation of the threshold; while with subject F., there was a slight effect; but with subjects Ho. and Hw., a relative remarkable depressed effect was observed. The duration of the effect was also varied in different subjects, ranging from 7 to 30 hours. The results are shown in Table 2 and Figures 1 to 4 inclusive. For saving considerable space, some readings appeared of same tendency were purposely omitted in the table.

On the other hand, the urine creatine was also determined for both before and after taking 5 gm. of creatine. The measurements of the total and preformed creatine were done by means of Jaffe's reaction⁸⁾ and of a

TABLE II.
The Effect of Creatine (5 gm.) on Dark Adaptation.

Time in dark (min.)	Log. Intensity ($\mu\mu$ l.)															
	Subject Ho.				Subject F.				Subject P.				Subject Hw.			
	Control	Time after creatine intake (hr.)			Control	Time after creatine intake (hr.)			Control	Time after creatine intake (hr.)			Control	Time after creatine intake (hr.)		
		1.0	6 $\frac{1}{2}$	30 $\frac{1}{2}$		5.0	23 $\frac{1}{2}$	30.0		1 $\frac{1}{2}$	6 $\frac{1}{2}$	25 $\frac{1}{2}$		1.0	23 $\frac{1}{2}$	30.0
1	6.03	5.93	6.02	5.93	5.73	5.77	5.81	5.78	6.24	6.32	6.26	6.19	5.68	5.67	5.71	5.70
2	5.87	5.80	5.95	5.74												
3					5.32	5.33	5.42	5.47	5.77	5.77	5.81	5.81	5.42	5.59	5.47	5.45
5	5.52	5.50	5.50	5.53	4.94	5.11	5.08	5.09	5.69	5.71	5.73	5.69	4.94	5.16	5.07	5.06
8	4.83	4.98	5.00	5.02	4.27	4.36	4.39	4.33	5.20	5.15	5.26	5.48	4.40	4.46	4.47	4.45
10					3.97	4.01	4.07	4.04	4.59	4.60	4.64	4.67	4.00	4.08	4.09	4.06
11	3.96	3.98	4.07	4.02												
15	3.27	3.44	3.43	3.43	3.10	3.15	3.20	3.17	4.17	4.15	4.17	4.14	2.97	2.99	3.02	3.02
20	2.91	3.04	3.09	3.05	3.03	3.01	3.08	3.08	3.74	3.73	3.76	3.79	2.72	2.80	2.81	2.79
25	2.77	2.88	2.95	2.84	2.91	2.95	3.00	2.91	3.43	3.47	3.44	3.51	2.53	2.76	2.73	2.65
30	2.56	2.69	2.76	2.72	2.79	2.81	2.91	2.81	3.30	3.26	3.35	3.38	2.46	2.56	2.61	2.53
35					2.73	2.80	2.79	2.78	3.12	3.13	3.14	3.13	2.36	2.51	2.51	2.47
40	2.23	2.47	2.53	2.33	2.70	2.73	2.78	2.76	3.11	3.11	3.13	3.10	2.35	2.46	2.51	2.46
50	2.18	2.36	2.39	2.23												

photoelectric spectrophotometer⁶⁾; the value of creatine as creatinine was obtained by minusing the latter from the former. We have noticed that before the intake of creatine, no creatine in the urine of all subjects was observed. But within 24 hours after the administration of creatine, creatinuria took place; the values of creatine as creatinine excreted by the subjects Ho., Hw., F. and P. were 1.37, 1.22, 1.10 and 0.41 gm. respectively. It seems that there was some correlation between the quantity of creatine excretion and the ability of dark adaptation, namely the more the former, the worse the latter.

In 1905, Hoogenhuyze and Verploegh²⁾ had noted that during and immediately after muscular exercise, a considerable rise of creatinine excretion was observed. Recently, Wendland¹⁰⁾ reported that after heavy

Fig. 1. The effect of creatine and methionine on dark adaptation for subject Ho.

Fig. 2. The effect of creatine and methionine on dark adaptation for subject F.

Fig. 3. The effect of creatine and methionine on dark adaptation for subject P.

Fig. 4. The effect of creatine and methionine on dark adaptation for subject Hw.

[illegible]

commenced about one hour after the methionine intake and lasted about 24–32 hours as indicated in Table III and also Figures 1 to 4 inclusive. If we use it for beneficial to night flying or for other purpose, it is worth a trial.

It is known that the regeneration of visual purple is correlated to the ability of dark adaptation. Recently, Hwang^{6,7)} has shown that the regeneration of visual purple is delayed by the administration of creatine and accelerated by the use of methionine in the frog. Our results indicated corresponding phenomenon in men, because after the creatine and methionine intake it produced the depression and improvement in dark adaptation respectively.

SUMMARY.

(1) After 5 gm. of creatine intake it produced a depressed effect on the ability of dark adaptation with rise in threshold. The effect varied in different individuals.

(2) After 5 gm. of methionine intake it produced an improved effect on the ability of dark adaptation with lowering of threshold. The duration of such effect lasted about 24–32 hours.

(3) The possible relationship between the effect of creatine and the effect after heavy muscular exercise on dark adaptation is suggested.

(4) The effects of creatine and methionine on the speed of visual purple regeneration and the ability of dark adaptation is discussed.

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