XX. THE CHEMICAL CHANGES TAKING PLACE IN THE PROTEINS OF MUSCULAR TISSUE WHEN PASSING INTO RIGOR.

BY HUMPHREY ROBERT HEWER, HATTI JAIRAM
AND SAMUEL BARNETT SCHRYVER.

*From the Biochemical and Zoological Departments of the Imperial College
of Science and Technology, London.*

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IN earlier papers it has been shown that gelatin, after treatment with even relatively dilute acids, yields a larger amount of the diamino-nitrogen fraction (precipitable by phosphotungstic acid) in the hydrolysis products than does untreated gelatin [Knaggs, 1923; Schryver and Buston, 1927; Thornley, 1927].

It was thought that the lactic acid produced during the contraction of muscular tissue might cause changes in the proteins of that tissue similar to those produced when gelatin is treated with acid. This was actually found to be the case. The experiments were carried out with the gastrocnemius and sartorius muscles of frogs. The hydrolyses were carried out by the micro-method of Thimann [1926]. By this method, the Hausmann numbers of the proteins could be determined in duplicate with small muscles of about 0.3 g. weight. The hydrolysis was always started by throwing the muscle into about four times its weight of boiling 20 % hydrochloric acid. When the muscle was thrown into acid immediately after excision from the animal, it gave a single twitch when coming into contact with the hot vapour or liquid. Under these conditions, about 30 % of diamino-nitrogen was obtained. If similar muscles were allowed to pass into rigor by remaining in a moist chamber for about 20 minutes at 40°, the diamino-nitrogen rose to about 36 %. The preliminary twitch could, however, be completely abolished by a previous treatment of the animal with either urethane or β -eucaine. Under these circumstances, the diamino-nitrogen of the muscles after hydrolysis sank to 26–27 %. If the muscles were allowed to pass out of rigor by standing for several hours in a moist chamber, the diamino-nitrogen sank from about 36 % (the number obtained for complete rigor) to about 30–31 %. The results are very analogous to the results obtained by the treatment of gelatin with acids.

Experimental details.

Frog I.

	Muscles hydrolysed directly after extirpation		Muscles allowed to pass into rigor by standing in moist chamber for 20 minutes at 40°	
	l. gastrocnemius	l. sartorius	r. gastrocnemius	r. sartorius
Amide-N	7.8 %	8.0 %	7.7 %	7.8 %
Humin-N	1.5	1.4	1.3	1.3
Diamino-N	29.6	29.7	35.5	35.5
Other N	60.8	60.9	56.0	56.0

Frog II. 1 cc. of urethane (in 0.5 % solution) was injected into the lymph spaces before extirpation of muscles.

	l. gastrocnemius	l. sartorius	r. gastrocnemius	r. sartorius
Amide-N	8.2 %	8.2 %	8.2 %	7.9 %
Humin-N	1.6	1.6	1.5	1.5
Diamino-N	25.9	25.8	26.0	25.9
Other N	63.8	63.9	64.1	64.2

Frog III. 2 cc. of 1 % β -eucaine solution was injected into lymph spaces before extirpation of muscle.

	l. gastrocnemius	l. sartorius	r. gastrocnemius	r. sartorius
Amide-N	7.9 %	7.3 %	8.0 %	7.5 %
Humin-N	1.5	1.3	1.5	1.4
Diamino-N	26.4	26.7	26.1	—
Other N	64.3	64.7	64.7	64.5

Frog IV. One pair of muscles was allowed to go into rigor by keeping at 40° for 20 minutes. In the other pair, rigor was allowed to pass off by keeping the muscles at 40° for 4 hours.

	Muscles in rigor		Muscles after disappearance of rigor	
	gastrocnemius	sartorius	gastrocnemius	sartorius
Amide-N	7.2 %	7.4 %	7.5 %	7.2 %
Humin-N	1.4	1.5	1.6	1.6
Diamino-N	36.0	35.5	31.2	31.1
Other N	55.3	55.6	59.8	60.0

Frog V. Muscles hydrolysed directly after extirpation.

	gastrocnemius	sartorius
Amide-N	7.8 %	7.3 %
Humin-N	1.5	1.5
Diamino-N	30.05	30.2
Other N	60.6	60.8

Frog VI. Muscles kept in moist chamber at 40° till rigor had completely passed off.

	gastrocnemius	sartorius
Amide-N	7.5 %	7.6 %
Humin-N	1.5	1.4
Diamino-N	30.8	30.6
Other N	60.1	60.2

All the above numbers are averages of two closely agreeing analyses. It will be observed that the amide-nitrogen varies only within narrow limits, whereas the diamino-nitrogen shows wide variations according to the state of the muscles.

REFERENCES.

- Knaggs (1923). *Biochem. J.* 17, 488.
 Schryver and Buston (1927). *Proc. Roy. Soc. Lond. B*, 101, 519.
 Thimann (1926). *Biochem. J.* 20, 1190.
 Thornley (1927). *Biochem. J.* 21, 1302.