
 COMMUNICATIONS TO THE EDITOR

METHIONINE AND ISOLEUCINE CONTENT OF MAMMALIAN HEMOGLOBINS. ITS SIGNIFICANCE FOR NUTRITIONAL AND METABOLIC STUDIES

Sirs:

Reports indicate that rats fail to grow when the only dietary protein is human or beef globin unless supplemented with isoleucine.^{1,2,3}

Adult dogs receiving dog hemoglobin as virtually the sole source of protein maintain approximate nitrogen balance with slight loss of weight.^{4,5} Dog hemoglobin supplemented with isoleucine is no better utilized.⁵ However, supplementation with methionine results in positive nitrogen balance and maintenance of, or slight gain in, weight.⁵ Further addition of isoleucine does not improve the effect of methionine.^{4,5}

The nutritive value of "hemoglobin" seems, therefore, to depend on experimental conditions. It will be shown, however, that the results are exactly what could be expected from the difference in isoleucine and methionine content of hemoglobins.

From the data in the accompanying table,

ISOLEUCINE AND METHIONINE CONTENT OF MAMMALIAN HEMOGLOBINS

Assumed Molecular Weight = 66,700

	Isoleucine ⁶			Methionine ⁷		
	Protein, %	M/10 ³ g.	M/m	Protein, %	M/10 ³ g.	M/m
Human ⁸	0	0	0	1.32	8.85	5.9
Dog ^{7,9}	1.36	10.4	6.9	0.42	2.81	1.9
Horse ¹⁰	0 ¹⁰	0	0			4 ¹²
Bovine, adult ¹³	0	0	0	1.76	11.8	7.9
Bovine, fetal ¹⁴	0.63	4.80	3.2	0.97	6.50	4.3

it can be seen that the isoleucine content of dog hemoglobin is appreciable (1.36%) whereas human, horse and adult bovine hemoglobins lack this amino acid.¹⁴

Methionine is present in all hemoglobins studied, to the extent of 1% or higher, except in dog hemoglobin (only 0.4%).

The amino acid requirements for hemoglobin formation would seem to be different in different

(1) Devline and Zittle, *J. Biol. Chem.*, **156**, 393 (1944).

(2) Albanese, *ibid.*, **157**, 613 (1945).

(3) Orten, Bourque and Orten, *ibid.*, **160**, 435 (1945).

(4) Whipple, Robschheit-Robbins and Miller, *Ann. N. Y. Acad. Sci.*, in press.

(5) Miller, *Federation Proc.*, **5**, 73 (1946).

(6) Microbioassay with *L. arabinosus* 17-5 and with *L. mesenteroides* P-60, cf. Brand, *et al.*, *THIS JOURNAL*, **67**, 1524 (1945).

(7) Microbioassay with *L. mesenteroides*.

(8) Prepared by R. K. Cannan and obtained from H. B. Vickery.

(9) Prepared by L. L. Miller.

(10) Prepared by G. L. Foster (*J. Biol. Chem.*, **159**, 431 (1945)).

(11) Microbioassay with *L. arabinosus*.

(12) Brand and Kassell, Abstracts, Am. Chem. Soc., Boston meeting, Sept. 1939.

(13) Prepared by Wyman, *et al.*, *J. Biol. Chem.*, **153**, 275 (1944), and obtained from H. B. Vickery, *ibid.*, **156**, 283 (1944).

(14) Devline and Zittle¹ and Albanese² report an isoleucine content of 0.29 and 0.8%, respectively, in human hemoglobin.

mammals. Whereas the human, the horse and cattle need for this purpose appreciable amounts of methionine but no isoleucine, the dog on the other hand needs isoleucine and only small amounts of methionine. The amino acid composition of hemoglobin is of metabolic significance since its breakdown contributes appreciably to the protein economy of an animal.

That fetal and adult bovine hemoglobins are two different proteins is again¹³ illustrated by the difference in their methionine and isoleucine content.

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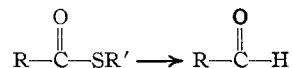
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A NEW ALDEHYDE SYNTHESIS

Sir:

In connection with our previous study on the hydrogenolysis of thioacetals,¹ it was apparent that the reductive desulfurization reaction therein described might be extended to compounds such as thiol esters in which case the corresponding aldehyde would be obtained.



This would be of particular interest in the sugar series since it would constitute a new method for synthesizing aldehyde derivatives. We have established the above reaction by the hydrogenolysis of the thiol esters of benzoic, propionic and tetraacetyl-D-ribonic acids which gave benzaldehyde, propionaldehyde and *aldehydo*-D-ribose tetraacetate, respectively.

The thiol esters were prepared by the reaction of the acid chloride with an excess of ethyl mercaptan in pyridine or by reaction of the acid chloride with lead mercaptide in dry ether (as for ethyl thiolpropionate, *b. p.* 133-135°). The hydrogenolyses were carried out with Raney nickel in 70-80% ethanol under reflux essentially as described¹ for the hydrogenolysis of thioacetals. After catalyst removal, benzaldehyde and propionaldehyde were isolated in the distillate as their bisulfite compounds in 60-70% yield and identified by definitive derivatives. The residual sirup obtained on hydrogenolysis of ethyl thiol-

(1) M. L. Wolfrom and J. V. Karabinos, *THIS JOURNAL*, **66**, 909 (1944).