3130

Observations on the diastase activity of the blood of infants.

GEORGE M. GUEST. (Introduced by James L. Gamble).

[*From the Department of Pediatrics, Harvard University, and The Children's Hospital, Boston, Mass.*]

In 1917 Myers and Killian[1] described a new simple method for the measurement of the diastatic, or starch-splitting, activity of blood. In this method two samples of 2 cc. each of oxalated blood, diluted with a given amount of water, to one of which was added 1 cc. of a 1 per cent solution of soluble starch, were heated in a water bath for 15 minutes at 40° C. and at the end of the digestion period the sugar content of each sample was measured. The difference, representing the amount of glucose liberated from the starch by the blood diastase, was converted into per cent of the original amount of starch (10 mg.), and this percentage figure was spoken of as the diastatic index or as diastatic units. They reported a considerable number of findings from the examination of the blood of healthy and diseased individuals, and later DeNiord and Schreiner,[2] Brill,[3] Watanabe,[4] and Lewis and Mason[5] reported clinical studies in which this method was used with slight modification. None of the results reported, however, gave evidence of constant variations in this diastatic power of the blood, which could be definitely correlated with the physical condition of the individuals studied. Karsner, Koechert, Wahl,[6] and Cohen[7] have reported studies of the variation of the blood diastase in animals under certain experimental conditions, using this method.

A study of the diastatic activity of the blood of infants and children, normal and otherwise, was undertaken with the hypo-

[1] Myers, V. C., and Killian, J. A., *J. Biol. Chem.*, 1917, xxix, 179.

[2] De Niord, H. H., and Schreiner, B. F., *Arch. Int. Med.*, 1919, xxiii, 484.

[3] Brill, I. C., *Arch. Int. Med.*, 1924, xxxiv, 542.

[4] Watanabe, C. K., *Am. J. Physiol.*, 1917, xlv, 30.

[5] Lewis, D. C., and Mason, E. H., *Am. J. Physiol.*, 1920, xliv, 455.

[6] Karsner, H. T., Koeckert, H. L., and Wahl, S. A., *J. Exp. Med.*, 1921, xxxiv, 349.

[7] Cohen, S. J., *Am. J. Physiol.*, 1924, lxix, 125.

thesis that the blood of infants suffering with various types of severe nutritional disturbances might show significant variations in the activity of the enzymes presumably responsible, in part, for the utilization of food substances. A brief summary of the findings among the infants will be presented.

In these studies the method of Myers and Killian has been changed somewhat for reasons which will not be given here, the principal change being the adoption of a digestion period of 1 hour instead of 15 minutes. Ordinary commercial corn starch was used instead of soluble starch because the samples of the latter which were available contained reducing sugars; the corn starch was free from such reducing substances and gave constant results in repeated check experiments. The dry incubator temperature of 37° C. was chosen for convenience, although the diastatics ferment is slightly more active at 40°.

Method: 2 cc. samples of oxalated blood placed in two 50 cc. Erlenmeyer flasks. One is diluted with 14 cc. H_2O, the other with 13 cc. H_2O, and the two placed in an incubator at 37° C. for one-half hour, to the second is then added 1 cc. of a 1 per cent starch solution and the two left at 37° for 1 hour. At the end of this digestion period the sugar content of each is measured by the Folin method,[8] they being ready for precipitation with the Na tungstate and H_2SO_4 solutions without further dilution. The difference between the values so obtained (the values being expressed as mg. of glucose per 100 cc. of blood) has been taken as an index of the diastatic activity of the blood sample; this figure actually represents the number of mg. of glucose which would be liberated in a proportionate mixture of 100 cc. of blood and 50 cc. of 1 per cent starch solution, under similar conditions.

In the normal infants and children studied there is a definite increase in the diastatic activity of the blood according to age; for infants of 2 months the index as here expressed is usually 20, while 35 to 40 is the average figure for those approaching 2 years, and for older children the average normal value is slightly higher.

The table given summarizes the findings from examinations of blood samples from approximately 100 infants less than 2 years of age.

[8] Folin, O., *J. Biol. Chem.*, 1926, lxvii, 357.

	Diastatic Index	
	Extremes	*Average*
1. Normal infants, and those admitted to the hospital for "Regulation of feeding"—cases apparently free from complicating infections. *16 cases:*	18–35	26
5 determinations among these cases, while they were doing poorly:	2–21	11
10 determinations among these cases, while they were doing well and gaining weight:	18–49	30
2. "Nutritional secondary anemias" (included the Von Jaksch type): *6 cases:*	20–58	44
3. Upper respiratory infections and pneumonia. *16 cases:*	25–146	58
4. Miscellaneous group of cases of generalized tuberculosis, congenital syphilis, rickets, meningococcus meningitis. *11 cases:*	20–51	33
5. "Acute intestinal intoxication" of varying degrees of severity. *43 cases:*	0–25 (1 case, only, above 18)	10
6 determinations among these cases shortly *preceding* the onset of the acute illness:	15–58	26
18 determinations among these cases *after* recovery:	20–54	33
6. Recovered cases of "Intestinal intoxication" (infants admitted to the hospital shortly after their illness, for other reasons; they were all apparently doing well) *5 cases:*	22–36	28

From the above data and experimental studies which have paralleled them, no definite conclusion has been drawn as to the significance of the striking changes in the starch-splitting activity of the blood of these infants, but it seems that the described index of this activity is fairly constant in those children in a good nutritional state, gaining weight and presenting no dietary difficulties, and that it is almost invariably diminished during certain of their acute nutritional disturbances. Most of the infants

showing the marked diminution in this index had diarrhea, either at the time of, or just previous to, the blood examinations, and since it is so generally believed that the amylolytic ferment of the blood is derived from the digestive juices, its diminution might be explained as due simply to exhaustion of the supply of the ferment by the profuse bowel movements. However, in the cases classified as intestinal intoxication, most of them being the familiar infantile summer diarrhea, the lowering of the diastatic index was not proportional to the severity or duration of the diarrhea but rather to the severity of the condition described clinically as "intoxication and dehydration"; moreover, some of the infants suffering more chronic nutritional disturbances, without diarrhea, during their most unfavorable periods have shown blood diastase values as low as those observed in cases of acute diarrhea. This observation seems to justify the conclusion that the diarrhea *per se* is not the important factor in diminishing the diastatic index. Whether during these disturbances a suppression of the secretion of the intestinal juices, with parallel lowering of the concentration of the enzymes in the blood, is an important factor in the infant's intolerance of food is a question open to speculation. The onset of pneumonia in infants is usually heralded by profuse diarrhea, yet the blood of these infants with pneumonia has shown markedly increased diastatic activity.

Experimental studies have shed little light on the significance of these observed changes. In rabbits certain bacterial toxins, particularly diphtheria toxin, have caused great increases in the blood diastase activity, changes comparable to those increases found in pneumonia in the infants, but as yet there has been found no way of causing noteworthy diminution of this activity in experimental animals.