The Change of Iodine Reaction and of Arakawa's Reaction on Administration of Vitamin B* in Lactating Mothers and Their Infants.

**154th Report of the Peroxidase Reaction.
(111th Human Milk Study.)**

By

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Introduction.

In my two preceding papers^{1) 2)} (Cf. the 145th and the 147th Reports of the Peroxidase Reaction) I published the results of study on iodine reaction of blood neutrophils. The former paper treated of the relation between Arakawa's reaction of milk and the iodine reaction of blood neutrophils in cases of lactating women, and the latter treated of the relation between the iodine reaction of blood neutrophils of infants and the Arakawa reaction of their lactating mothers. In these studies I observed that mothers secreting Arakawa-negative milk and also infants nursed with such milk showed positive iodine reaction, and attributed this result of reaction to B-avitaminosis.

In the present treatise I shall report the change which may occur on an administration of vitamin B. If the positive iodine reaction of blood leucocytes of Arakawa-negative mothers and their infants is to be attributed to B-avitaminosis, then the positive reaction will, as I presume, change to negative reaction on vitamin B administration.

Method of Investigation.

1. Materials. Blood smears were obtained from both mother and infant who visited our Dispensary.

* B means B₁ throughout the article.

1) K. Isizaka, Tohoku J. Exp. Med., 1941, **40**, 39.

2) K. Isizaka, Tohoku J. Exp. Med., 1941, **40**, 145.

2. Arakawa's reaction of mother's milk was tested as described in the preceding paper of mine¹⁾; and mothers and infants who had Arakawa-negative or weakly Arakawa-positive milk were objects of the present investigation.

3. For the purpose of examining the iodine reaction of blood neutrophils Kiyokawa's³⁾ modification of Ehrlich's method was used. The technique was described in my preceding paper¹⁾.

TABLE 1.
Case 1. T. Hattori.

	Date	Arakawa's reaction	Iodine reaction of blood neu- trophils (%)			Remark
		R=right L=left 0' 1' 2' 3' 4' 5'	-	+	++	
Mother 27 years	1. III	R - - - - ± ± L - - - - ± ±	0	60	40	Daily administration of beriberol (3 grms.) and ebios (3 grms.) and injection of vitamin B ₁ * (1 grm.) every other day
	14. "	R - ± + + + + L - + + # # # #	50	50	0	
	23. "	R - ± ± ± + + L - ± + + + +	52	48	0	
	1. III		0	80	20	
	14. "		74	24	0	
	23. "		80	20	0	
Infant 3 months	1. III		0	80	20	Injection of vitamin B ₁ (0.5 mgrms.) every other day
	14. "		74	24	0	
	23. "		80	20	0	

Case 2. Y. Matsumoto.

Mother 32 years	2. II	R - - ± ± + + L - - ± ± + +	0	60	40	Daily administration of oryzanin (5 mgrms.) ebios (6 grms.) and injection of vitamin B ₁ (0.5 mgrms.) every 3 days
	17. III	R ± + + # # # # L - ± + + # # # #	32	68	0	
	2. II		100	0	0	
	17. III		100	0	0	
Infant 2 months	2. II		100	0	0	Daily administration of liq. oryzanin (5 c.c.)
	17. III		100	0	0	

* Vitamin-B preparations used in this experiment were as follow:

Injectio metabolin (Takeda) and injectio oryzanin (Sankyo) are used subcutaneous-ly as pure vitamin-B₁ preparations (B₁-content was described with mgrm.).

Liq. oryzanin (Sankyo) 1 cc.=vitamin B₁ claimed to contain 6 international units in it then.

Oryzanin (Sankyo) 1 grm.=Vitamin B₁ claimed to contain 40 international units in it then.

Liq. beriberol (Radium Co.) 1 c.c.=vitamin B₁ claimed to contain 1.02 international units in it then.

Beriberol (Radium Co.) 1 grm.=

Ebios (Tanabe) 1 grm.=vitamin B₁ claimed to contain 15-27 international units in it then.

3) Y. Kiyokawa, Rinsyo Syonika Zassi, 1932, No. 9, 25.

Case 3. K. Shoji.

	Date	Arakawa's reaction						Iodine reaction of blood neutrophils (%)			Remark
		R=right		L=left				-	+	++	
Mother 25 years	14. III	R	-	-	-	-	-	68	32	0	Daily administration of oryzanin (3 grms.) and ebios (5 grms.) and injection of vitamin B ₁ (0.5 mgrms.) every other day
		L	-	-	-	-	-				
	22. "	R	-	-	-	-	-	0	100	0	
		L	-	-	-	-	-				
	15. IV	R	-	-	-	-	-	0	100	0	
		L	-	-	-	-	-				
Infant 38 days	14. III							0	20	80	Daily administration of liq. oryzanin (3 grms.) and ebios and injection of vitamin B ₁ (0.5 mgrms.) every other day
	22. "							0	68	32	
	15. IV							85	15	0	

Case 4. R. Hagita.

Mother 30 years	24. IV	R	-	-	±	±	+	++	0	80	20	Daily administration of beriberol (3 grms.) and ebios (3 grms.) and injection of yakriton†, 1/2 R.A.U., and vitamin B ₁ (0.5 mgrms.) every other day
		L	-	±	±	+	++	++				
	4. V	R	-	+	++	+++	+++	+++	25	75	0	
		L	-	++	+++	+++	+++	+++				
	14. " *	R	-	±	±	+	+	+	0	88	12	
		L	-	±	±	+	+	+				
	10. VI	R	-	++	+++	+++	+++	+++	100	0	0	
		L	-	+++	+++	+++	+++	+++				
Infant 6 months	24. V								40	60	0	Daily administration of liq. beriberol (3 c.c.) and ebios (0.5 grms.) and injection of vitamin B ₁ (0.5 mgrms.) every other day
	4. "								0	60	40	
	14. "								24	76	0	
	10. VI								100	0	0	

* Mother had been suffering from acute gastroenteritis.

† Yakriton... the detoxicating hormone of the liver; R. A. U.=Rabbit-Ammonia-Units; used to fortify the effect of vitamin B.

Case 5. M. Endo.

Mother 26 years	5. V.	R	-	-	-	-	-	0	100	0	Injection of vitamin B ₁ (0.5 mgrms.) and yakriton*, (1/2 R.A.U.) every other day
		L	-	-	-	-	-				
	12. "	R	-	-	-	-	± ±	0	100	0	
		L	-	-	-	-	±				
	26. "	R	-	-	±	+	++	75	25	0	
		L	-	-	±	+	++				
Infant	5. V							80	20	0	Injection of vitamin B ₁ (0.5 mgrms.) every other day
	12. "							100	0	0	
	26. "							100	0	0	

* Cf. Foot note to Case 4.

Case 6. H. Sugawara.

	Date	Arakawa's reaction R=right L=left 0' 1' 2' 3' 4' 5'	Iodine reaction of blood neu- trophils(%) - + ++	Remark
Mother 30 years	20. IX	R - + + ++ ++ L - - ± + + +	0 80 20	After 6 times of injection of vitamin B ₁ (0.5 mgrms.)
	27. "	R - + + ++ ++ L - - ± + + +	100 0 0	
Infant 12 months	20. IX		0 100 0	7 days after daily administration of liq. oryzanin (5 c.c.) and ebios (1 grm.)
	27. "		40 60 0	

Case 7. K. Ando.

Mother 27 years	19. IX	R - ± ± ± ± ± L - ± ± ± ± ±	0 0 100	Has been taking vitamin B about a month. Further in our Dispensary, daily administration of oryzanin (6 grms.) and injection of vitamin B ₁ (0.5 mgrms.) every other day
	30. "	R - + ++ ++ ++ L - ± + + + +	12 88 0	
	7. X	R - ± + + ++ ++ L - - ± + + +	100 0 0	
	14. "	R - ± + ++ ++ L - ± ± + + +	100 0 0	
Infant 65 days	19. IX		88 12 0	Daily administration of liq. oryzanin (3 c.c.)
	30. "		100 0 0	
	7. X		56 44 0	
	14. "		100 0 0	

Case 8. M. Ito.

Mother 32 years	20. X	R - ++ ++ ++ ++ L - ++ ++ ++ ++	0 0 100	(Hypogalactia)
	7. XI	R + ++ ++ ++ ++ L - + ++ ++ ++	100 0 0	After 6 times of injection of vitamin B ₁ (0.5 mgrms.) and yakriton* 1/2 R.A.U.
Infant 2 months	20. X		0 28 72	Daily administration of liq. oryzanin (3 c.c.) and ebios (0.5 grms.)
	7. XI		100 0 0	

* Cf. Foot note to Case 4.

Case 9. Y. Suzuki.

Mother 25 years	28. X	R - + + + ++ ++ L - + ++ ++ ++	28 72 0	Injection of vitamin B ₁ (0.5 mgrms.) and yakriton† (0.5 c.c.) every other day
	9. XI	R - + + + ++ ++ L ± ++ ++ ++ ++	88 12 0	
	15. "		100 0 0	
	22. "	R - - ± ± ± + L ± + ++ ++ ++	100 0 0	
Infant 3 months	28. X		75 25 0	Daily administration of liq. oryzanin (5 c.c.) and ebios (0.5 grms.)
	9. XI		100 0 0	
	15. "		100 0 0	
	22. "		100 0 0	

† Cf. Foot note to Case 4.

Case 10. Y. Mukaiyama.

	Date	Arakawa's reaction						Iodine reaction of blood neutrophils (%)			Remark
		R=right			L=left			-	+	++	
Mother 31 years	29. IX	R	-	+	+	+	++	60	40	0	Injection of vitamin B ₁ (0.5 mgrms.) every other day
		L	-	+	+	+	++				
	7. X	R	-	±	+	+	++	72	28	0	
		L	±	+	+	+	++				
	14. "	R	-	-	±	+	+	100	0	0	
		L	-	+	+	+	++				
Infant 33 days	29. IX							100	0	0	Injection of vitamin B ₁ (0.25 mgrms.) every other day
	7. X							100	0	0	
	14. "							100	0	0	

Case 11. K. Ieda.

Mother 27 years	21. IX	R	-	±	+	+	++	0	100	0	Injection of vitamin B ₁ (0.5 mgrms.) and yak- riton† every other day
		L	-	±	+	+	++				
	26. "	R	±	+	+	+	++	32	68	0	
		L	±	±	+	+	++				
	1. X	R	±	+	+	+	++	100	0	0	
		L	±	+	+	+	++				
Infant 6 months	21. IX							52	48	0	Injection of vitamin B ₁ (0.25 mgrms.) every day
	26. "							60	40	0	
	1. X							100	0	0	

† Cf. foot note to Case 4.

Case 12. T. Tomita.

Mother 29 years	28. X	R	-	-	-	-	-	100	0	0	Injection of vitamin B ₁ (0.5 mgrms.) every other day
		L	-	-	-	-	-				
	7. XI	R	-	-	-	-	-	100	0	0	
		L	-	-	-	-	-				
	26. "	R	-	-	-	-	±	100	0	0	
		L	-	-	-	±	±				
Infant 72 days	28. X							40	60	0	Injection of vitamin B ₁ (0.25 mgrms.) every other day
	7. XI										
	26. "							90	10	0	

Case 13. T. Kansaku.

Mother 27 years	11. XI	R	-	-	-	-	+	12	88	0	Injection of vitamin B ₁ (0.5 mgrms.) every other day
		L	-	-	-	-	-				
	19. "	R	-	-	-	-	-	0	0	100	
		L	-	-	-	-	-				
	28. "	R	-	-	-	-	-	60	40	0	
		L	-	-	-	-	-				
Infant 46 days	11. XI							0	100	0	Injection of vitamin B ₁ (0.5 mgrms.) every other day
	19. "							100	0	0	
	28. "							100	0	0	

Case 14. S. Tida.

	Date	Arakawa's reaction	Iodine reaction of blood neu- trophils (%)			Remark
		R=right L=left 0' 1' 2' 3' 4' 5'	-	+	++	
Mother 29 years	31. X	R - - - ± + + L - - ± ± + +	32	68	0	Has been taking vita- min B ₁ about 3 weeks. Further, injection of vitamin B ₁ (0.5 mgrms.) every other day
	9. XI	R - ± + + # # # L - ± + + # # #	100	0	0	
	18. "	R - + + + # # # L - ± ± + + +	100	0	0	
Infant 3 months	31. X		60	40	0	Daily administration of liq. oryzanin (3 c.c.) and ebios (0.5 grms.) and injection B ₁ (0.25 mgrms.) every other day
	9. XI		0	20	80	
	18. "		100	0	0	

Case 15. A. Sako.

Mother 30 years	17. XI	R - ± + + + # L - - - - - ±	0	80	20	Daily injection but holiday of vitamin B ₁ (0.5 mgrms.)
	24. "	R - ± + + # # # L - - ± ± ± ± ±	60	40	0	
	1. XII	R - + + + # # # L - - ± ± ± ± ±	80	20	6	
Infant 3 months	17. XI		100	0	0	Daily administration of liq. beriberol (5 c.c.) and ebios (0.5 grms.)
	24. "		100	0	0	
	1. XII		100	0	0	

Case 16. K. Sato.

Mother 21 years	7. XI	R - - - - - L - - ± ± + +	0	100	0	Injection of vitamin B ₁ (0.5 mgrms.) every other day
	12. "	R - - - - - L - ± + + + # #	100	0	0	
	18. "		85	15	0	
	30. "	R - - - - ± + L - - ± ± + +	100	0	0	
Infant 78 days	7. XI		0	100	0	Injection of vitamin B ₁ (0.5 mgrms.) every other day
	12. "		100	0	0	
	18. "		80	20	0	
	30. "		100	0	0	

Case 17. H. Hasekura.

Mother 28 years	20. X	R - ± + + + # L - + + + # #	0	80	20	Daily administration of beriberol (3 grms.) and injection of vitamin B ₁ (1 mgrm.) every other day
	4. XI	R - + + + # # # L - # # # # #	100	0	0	
Infant 57 days	20. X		0	100	0	Injection of vitamin B ₁ (0.5 mgrms.) every other day
	4. XI		100	0	0	

Case 18. H. Kan.

	Date	Arakawa's reaction						Iodine reaction of blood neutrophils (%)			Remark
		R=right		L=left				-	+	++	
		0'	1'	2'	3'	4'	5'				
Mother 38 years	20. IX	R	-	+	+	++	++	0	80	20	Injection of vitamin B ₁ (0.5 mgrms.) every other day
		L	-	-	±	+	+				
	30. "	R	-	+	+	++	++	100	0	0	
		L	-	-	±	+	+				
Infant 14 months	20. IX							0	100	0	Injection of vitamin B ₁ (0.25 mgrms.) every other day
	30. "							40	60	0	

Case 19. T. Matumoto.

Mother 37 years	17. II	R	±	+	+	++	++	++	++	0	100	0	Until 4. III daily administration of beriberol (3 grms.) and ebios (3 grms.) and injection of vitamin B ₁ (0.5 mgrms.) every other day
		L	±	+	+	+	+	+	+				
	25. "	R	+	+	+	++	++	++	++	100	0	0	
		L	+	+	+	++	++	++	++				
	4. III	R	±	+	+	++	++	++	++	100	0	0	Thereafter injection of vitamin B ₁ (1 mgrm.) every other day
		L	+	+	+	++	++	++	++				
	15. "	R	±	+	+	++	++	++	++	84	16	0	
		L	±	+	+	++	++	++	++				
Infant 3 months	22. "	R	+	+	+	++	++	++	++	100	0	0	Daily administration of liq. oryzanin (5 c.c.) and beriberol (0.5 grms.) and injection of vitamin B ₁ (0.5 mgrms.) every other day
		L	+	+	+	++	++	++	++				
	17. II									0	100	0	
	25. "									100	0	0	
	4. III									100	0	0	
	15. "									0	60	40	
	22. "									84	16	0	

Case 20. T. Otuki.

Mother 25 years	18. III	R	-	-	-	-	-	-	±	0	100	0	Injection of vitamin B ₁ (0.5 mgrms.) and yak-riton† (0.5 c.c.) every other day
		L	-	-	-	-	-	-	±				
	25. "	R	-	-	±	±	+	+	+	25	75	0	
		L	-	±	+	+	+	+	+				
	8. IV	R	-	±	±	+	+	+	+	100	0	0	
		L	-	+	+	+	+	+	++				
	17. "	R	-	+	+	++	++	++	++	100	0	0	
		L	-	+	+	++	++	++	++				
Infant 4 months	28. "	R	-	±	+	+	++	++	++	100	0	0	Daily administration of liq. oryzanin (5 c.c.) and beriberol (1 grm.) and injection of vitamin B ₁ (0.5 mgrms.) every other day
		L	±	+	+	++	++	++	++				
	18. III									32	68	0	
	25. "									40	60	0	
	8. IV									100	0	0	
	17. "									88	12	0	
	28. "									100	0	0	

† Cf. Foot note to Case 4.

Results of Investigation.

Arakawa's reaction will, as Arakawa's experiment⁴⁾ shows, change from negative to positive on an administration of vitamin B, though the amount of this differs according to cases. This experiment was further confirmed by Takamatsu⁵⁾. Lactating mothers with Arakawa-negative milk seen in our daily practice are not acute cases of B-avitaminosis, of course, and a daily administration of vitamin B in a not very large amount cannot easily make an Arakawa-negative case Arakawa-positive, but when mothers with Arakawa-negative milk are taking vitamin B, the milk is losing its toxicity or its content in a glyoxal-like substance or substances, even if it still remains negative to Arakawa's reaction. This is what was shown by Takamatsu⁴⁾.

In the present work, I treated cases of B-avitaminosis or those who were running near it.

In all the cases except No. 7 and No. 17 neither mother nor infant had been taking vitamin-B preparations. In all the cases the mother's iodine reaction was more or less positive at the first examination, but it became gradually weaker or entirely negative on an administration of vitamin B. This tendency was also seen in the infant. In most cases except for Nos. 2, 3, 9, 10, 12 and 15 an improvement of Arakawa's reaction of milk was seen on an administration of vitamin B, while the iodine reaction went from positive to *negative*—or to the normal reaction—in both mother and infant. In No. 2, No. 9, No. 10 and No. 15 the iodine reaction of infant was negative from the very first examination, but that of the mother showed the decrease on an administration of vitamin B. In No. 3 and No. 12 Arakawa's reaction and iodine reaction of mothers showed no perceptible improvement on an administration of vitamin B, but the iodine reaction of the infants in these cases showed a remarkable decrease—a change to the normal reaction.

Summary.

In my preceding papers^{1) 2)} I stated from the view point of positive iodine reaction that a mother with Arakawa-negative milk and an infant nursed with such a milk are already in a state of avitaminosis B. In the present paper I saw a change of the reaction on an administration of vitamin B—from positive to *negative* (or to the normal reaction).

4) T. Arakawa, Tohoku J. Exp. Med., 1930, 16, 107.

5) A. Takamatsu, Tohoku J. Exp. Med., 1934, 23, 46.

This result shows again that mothers with milk negative to Arakawa's reaction and their infants are already in a state of B-avitaminosis.

Conclusion.

Blood leucocytes of mothers and infants with weak or negative Arakawa's reaction show the positive iodine reaction of blood neutrophils. An administration of vitamin B will restore the positive iodine reaction to the normal (*negative*).

From these two facts it will be seen that mothers with milk negative (or weakly positive) to Arakawa's reaction and infants nursed with such milk are in a state of B-avitaminosis.