Acta Paediatrica Academiae Scientiarum Hungaricae Vol. 9 (1), pp. 59—64 (1968)

Pantothenic Acid: Its Role in Infant Feeding

By

I. Szórády and Magda Telegdy-Kováts

Municipal Children's Hospital, Szeged; Institute of Nutrition, Budapest

(Received April 19, 1967)

Recent investigations have proved that pantothenic acid, a member of the vitamin B complex, has an unexpectedly high paediatric significance [23 to 27, 29 to 31]. Its recently discovered pharmacological effects are likewise important [5, 7, 8, 30, 32]. The human organism cannot dispense with pantothenic acid since this constitutes about 90% of the substance of coenzyme-A.

The supply of pantothenic acid is partly endogenous (biosynthesis by intestinal bacteria) and partly exogenous (food). The amount of biosynthetic pantothenic acid is unknown [9, 21], nor do we know how much thereof is absorbed [18] and how much is utilized for the metabolism of the microorganism themselves. Estimation of the amount of endogenous pantothenic acid is made still more difficult by changes of the intestinal flora in infancy and childhood. Biosynthesis by the Lactobacillus flora of breast-fed infants is still a controversial problem [19, 21]. It is in any case certain that the amount of excreted pantothenic acid always exceeds its uptake and that the excess is endogenous.

Foodstuffs are the exogenous sources of pantothenic acid [25]. Recent tables of food preparations contain sufficient information about the pantothenic acid contents of infant foods [11, 27]. Mother milk, for instance, contains 0.25 ($\pm$0.01) mg/100 g; cow milk, 0.39 ($\pm$01) mg/100 g. Powdered milk [4, 11, 16] and food preparations [4, 13, 14, 16, 20] greatly vary in pantothenic acid content, but in single preparations this is fairly stable [2], especially in deep-frozen foods [3, 17]. Industrial manipulation and culinary preparation (boiling) cause a considerable loss of pantothenic acid.

In view of the ignorance concerning the amount of endogenous pantothenic acid and the wide scattering of data in its intake, a study has been made of the pantothenic acid content of some infant foods in order to gain insight into the pantothenic acid supply of healthy, well-fed infants and to make certain conclusions in this connection.

Material and Method

The food preparations examined were Adapta, Predapta, Oriza, Lactorizan and

Maltiron.* The pantothenic acid contents of the basic substances, the finished product, and that of the dissolved material ready for consumption was determined separately. Each examination was made in triplicate. The total number of examinations exceeded 200.

A modified form of ATKIN's microbiological method was used, with *Saccharomyces carlsbergensis* = ATCCo : 80 [1]. Details of the procedure have been described previously [33].

RESULTS

First, the pantothenic acid contents of the basic substances of the examined preparations were compared with that of the finished products. It is evident from Table I that the two values were in agreement.

TABLE I

Food preparation	Amount of pantothenic acid (μg per 100 g)		Difference, per cent
	Value based on the contents of the basic substances	Actual value	
Adapta	1475	1304	—11.5
Predapta	1797	1483	—17.4
Oriza	95	94	— 1.0
Lactorizan	369	584	— 3.8
Maltiron	1012	904	—10.6

The next step was to compare the pantothenic acid contents estimated by us earlier [25] with that determined by the microbiological method. It can be seen from Table II that — except for Lactorizan — the two values were in agreement within the permissible limits of error ($\pm 20\%$).

Table III shows the pantothenic acid contents of the food products in a dissolved condition, ready for consumption, and affords, at the same time, information on losses due to culinary management.

DISCUSSION

The reliability of the employed method was borne out by the fact that the sum of the pantothenic acid contents of the components agreed with the amount of pantothenic acid found in the marketed products. This seemed to justify some conclusions.

The pantothenic acid values determined 4 years earlier failed to agree with the microbiologically determined amount in a single case only, namely in respect of Lactorizan which contained considerably less than the expected amount of pantothenic acid. This deficit was due to that the powdered milk used for the preparation of this infant food was poorer in pantothenic acid than the other powdered milks.

Comparison with foreign products was based on literary data [13, 15, 20]. Comparisons of this kind were instructive, for — except Oriza — all products listed in Table IV are powdered milk preparations with a caloric value of about 70. It is evident from the list (in which the names of foreign products are italicized) that only Adapta and Predapta (Hungary), Ki—Na (GDR) and Nutramigen (USA)

* All these products are manufactured by the United Pharmaceutical Works, Budapest, and we are indebted to their Medical Department for supplies of the preparations.

TABLE II

Food preparation	Characteristics	Composition	Pantothenic acid content (μg per 100 g)		Difference of microbiological from estimated value per cent
			Estimated value 1962	Value determined microbiologically (1967)	
Adapta	Moderately acid powdered milk of artificial buttermilk character	65% powdered milk containing 16.7% of fat; 30% degraded starch; 5% saccharose; 0.15% betaine hydrochloride; 0.0025% vitamin B_1; 0.0025% vitamin B_2; 0.1% vitamin C	1600	1304	—19
Predapta	Powdered skimmed milk of artificial buttermilk character for prematures	70% powdered skimmed milk; 27% degraded starch; 3% saccharose; 0.14% betaine hydrochloride; 0.0025% vitamin B_1; 0.0025% vitamin B_2; 0.05% vitamin C	1800	1483	—18
Oriza	Dried rice pap enriched with carbohydrate, for milk formula	50% rice pap; 50% maize starch; 0.005% vitamin B_1; 0.005% vitamin B_2	80	94	—17
Lactorizan	Powdered full milk enriched with rice pap and saccharose, for prolonged feeding	50% powdered milk containing 26% fat; 36% degraded starch; 14% Oriza; 0.0025% vitamin B_1; 0.0025% vitamin B_2; 0.1% vitamin C	1310	584	—44
Maltiron	Powdered full milk	40% powdered skimmed milk, containing 11.2% fat; 25% Oriza; 35% degraded starch	980	904	—15

TABLE III

Food preparation	Pantothenic-acid content (μg per 100 ml)
Adapta	222
Predapta	297
Oriza	5
Lactorizan	100
Maltiron	90

contained the same amount of pantothenic acid as does mother or cow's milk.

Relying on literary data [10, 22] it was stated [25] that the daily pantothenic acid requirement of infants is 1.7 to 4.7 mg. It was furthermore demonstrated that even the qualitatively and calorically best current infant foods fail to satisfy the minimal requirement before the age of 6 months (Table V). These earlier findings have now been confirmed by microbiological assay so that it is irrefutably evident that, with the usual diets, babies under six months (including prematures and neonates) do not receive the required quantity of pantothenic acid. Although newborn babies are able to make up the deficit from their congenital depot, it is not known how long such reserves can last. The quantity of endogenous pantothenic acid at that age is limited on account of the variability of the intestinal flora, biosynthesis by Lactobacilli being questionable, and, in bottle-fed infants, owing to the alkalinity of the intestines. Besides, part of the exogenous pantothenic acid is consumed by the microorganisms themselves. Dietary errors, malabsorption, ailments, surgical interventions, dehydration, enteric infections, treatment with broad-spectrum antibiotics, various dysbacterioses, etc., decrease the pantothenic acid supply. Their importance is obvious and has been stressed by several authors [6, 12]. We, too, have observed significantly low blood pantothenic acid levels and sometimes a negative pantothenic acid balance in diseased babies [26, 28].

TABLE IV

Food preparation	Pantothenic acid content (μg per 100 ml)
Oriza	5
Maltiron	90
Humana-0	90
Lactorizan	100
2/3 condensed milk	130
Adapta	222
Ki — Na	240
Predapta	297
Nutramigen	320

Mother's milk, 250 ± 10 μg per 100 ml

Cow's milk, 390 ± 100 μg per 100 ml

TABLE V

Age	Pantothenic acid daily requirement	Pantothenic acid ingested daily amount	Uptake in per cent of requirement
Prematures	1.7	0.8	44
Neonates	1.8	1 —1.1	58
3—4 m.	2.7	1.5—1.7	59
6 months	3.7	4	108
10 months	4.7	5.8	123

Until a more thorough knowledge of the degree of biosynthesis will have been attained it is undoubtedly neces-

sary to raise the pantothenic acid contents of infant foods at least to 500 to 700 μg per 100 ml and, in the meantime, to supplement the diet of young babies by the administration of pantothenic acid preparations.

Summary

Healthy newborn babies, prematures and young infants, however well fed, do not receive the necessary amount of pantothenic acid as infant's foods, powdered milk, and even mother's and cow's milk do not contain that amount of pantothenic acid which would satisfy the daily requirement of 1.7 to 3.7 mg. It is therefore imperative to enrich the food preparations with pantothenic acid and — in the meantime — to administer pantothenic acid to diseased infants below the age of six months.

References

1. Atkin, L., Williams, W. L., Schultz, A. S., Frey, C. N.: Yeast microbiological methods for determination of vitamins (Pantothenic acid). Ind. Eng. chem., anal. Edit. **16,** 67 (1944).
2. Best, Ch. H.: The physiological basis of medical practice. 7th ed. Williams Wilkins, Baltimore 1961.
3. Burr, H. K., Elliott, R. P.: Quality and safety in frozen foods. J. Amer. med. Ass. **174,** 1178 (1960).
4. Ceglédi-Jankó, G.: A magyar tápszergyártás helyzete. Népegészségügy **45,** 51 (1964).
5. Dombrádi, G. A., Szepesvári, E., Szórády, I.: The possible mode of action of pantothenic acid in radioprotection. Acta physiol. latino-amer. **14,** 327 (1964).
6. Gassmann, B., Haenel, H.: Über den Vitaminbedarf und dessen Deckung im frühen Kindesalter. Pädiat. u. Grenzgeb. **3,** 75 (1964).
7. Gábor, M., Szórády, I., Antal, A., Dirner, Z.: Beiträge zu den pharmakologischen Wirkungen der Pantothensäure. Int. Z. Vitaminforsch. **35,** 257 (1965).
8. Gábor, M., Szórády, I., Madácsy, M.: Über die kapillarresistenzbeeinflussende Wirkung der Pantothensäure. Naturwissenschaften **51,** 362 (1964).
9. Goldsmith, G. A.: Intestinal flora, nutrition and metabolism. Amer. J. Digest. Dis. **10,** 829 (1965).
10. Haenel, H.: Darmflora und Vitaminhaushalt. Ernährungsforschung **3,** 282 (1958).
11. Hardings, M. G., Crooks, H.: Lesser known vitamins in foods. J. Amer. diet. Ass. **38,** 240 (1961).
12. Hejda, S., Osancová, K.: Preliminary assessment of the pantothenic acid intake of the population. Čs. Gastroent. Vyz. **18,** 560 (1964).
13. Herbst, R.: Über den Einfluß der adaptierten Milch auf die Frühgeborenen-Aufzucht. Z. Kinderheilk. **98,** 208 (1967).
14. Heupke, W., Fischer, H.: Devitaminisierung der Nahrung. Münch. med. Wschr. **99,** 1575 (1957).
15. Horn, W.: Milchpräparate für die Ernährung gesunder Säuglinge in der DDR. Medicamentum **4,** 113 (1962).
16. Jochims, J.: Fragekasten (Brief). Kinderärztl. Prax. **22,** 141 (1964).
17. Kallistratus, G., von Sengsbusch, R.: Vergleichende Untersuchungen über die Verluste verschiedener Nahrungsmittelsbestandteile durch Gefriertrocknung und durch andere Trocknungsarten. Nutr. et Dieta (Basel) **6,** 193 (1964).
18. Kasper, H., Hötzel, D.: Untersuchungen zur Frage der Vitaminresorption im Dickdarm. Z. Ernährungsw. **4,** 34 (1963).
19. Liebscher, S.: Sind die im Darm des mit Muttermilch ernährten Säuglings vorherrschenden Bifidusbakterien als nützliche Vitaminlieferanten für den Säuglingsorganismus anzusehen? Z. Kinderheilk. **85,** 265 (1961).
20. *Report of the Committee on Nutrition:* Appraisal of nutritional adequacy of infant formulas used as cow milk substitutes. Pediatrics **31,** 329 (1963).
21. Rerat, A.: Role de la flore digestive dans la production des vitamines chez les monogastriques et les polygastri-

ques. Ann. Nutr. (Paris) **18,** C 187 (1964).
22. Schmidt, V.: Die klinische Bedeutung der Pantothensäure. Z. Vitamin-, Hormon- u. Fermentforsch. **4,** 480 (1951).
23. Szórády, I.: Über die Pantothensäurebehandlung des paralytischen Ileus und der Darm-Atonie (Subileus) im Säuglings- und Kindesalter. M. Kinderheilk. **107,** 249 (1959).
24. Szórády, I.: Die klinische Bedeutung der Pantothensäure. Neue ost. Z. Kinderheilk. **2,** 107 (1960).
25. Szórády, I.: Die diätetische Bedeutung der Pantothensäure im Kindesalter. M. Kinderheilk. **111,** 10 (1963).
26. Szórády, I.: Pantothenic acid: experimental results and clinical observations. Acta paediat. Acad. Sci. hung. **4,** 73 (1963).
27. Szórády, I.: Die klinische Bedeutung der Pantothensäure, unter besonderer Berücksichtigung der Kinderheilkunde (Dissertation). Studia Medica Universitatis Szegediensis, Szeged 1967.
28. Szórády, I.: Unpublished data.
29. Szórády, I., Gábor, M., Madácsy, L.: Pantothenic acid: its effect on capillary resistance in children. Acta paediat. Acad. Sci. hung. **6,** 95 (1965).
30. Szórády, I., Horváth, E., Tóth, E.: Über die Antihistaminwirkung der Pantothensäure. Int. Z. Vitaminforsch. **36,** 126 (1966).
31. Szórády, I., E. Nagy, M., Bakacsi, G.: Pantothenic acid: its metabolic effects in normal children. Acta paediat. Acad. Sci. hung. **5,** 241 (1964).
32. Szórády, I., Tóth, Gy., Gazdag, I.: X-Ray protection by means of pantothenic acid. Progr. Biochem. Pharmacol. **1,** 533 (1965).
33. Telegdy Kováts, M., Szórády, I.: Der Pantothensäuregehalt verschiedener Säuglingsnährmittel. Int. Z. Vitaminforsch. **37,** 343 (1967).

I. Szórády,
Gyermekkórház, Szeged
Hungary