



BIOTIN

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Indications

Biotin (coenzyme R, vitamin H) is an essential micronutrient for all mammals and is a water-soluble member of the B complex group of vitamins [1]. Biotin functions as the coenzyme for four carboxylase enzymes: pyruvate carboxylase (EC 6.4.1.1), acetyl-CoA carboxylase (EC 6.4.1.2), propionyl-CoA carboxylase (EC 6.4.1.3) and methylcrotonyl-CoA carboxylase (EC 6.4.1.4) [2,3]. Biotin therefore has an essential role in the metabolic pathways of gluconeogenesis, fatty acid synthesis and the metabolism of amino acids [2-4]. Biotinylation of histones appears to be important in embryological development [2] and there is evidence that marginal maternal biotin deficiency is teratogenic to the foetus [2,6].

Poor biotin status has been recorded in pregnancy [1,5], in the elderly and in athletes [5]. Biotin deficiency has also been linked to impaired glucose tolerance, with an inverse correlation between serum biotin and fasting blood glucose concentrations [5]. Biotin status is reduced by smoking [1] and by anticonvulsant therapy [1,2,6]. Raw egg white contains the protein avidin, which can bind tightly to biotin in the gut and prevent its absorption [2]. Long term consumption of undenatured egg white may thus produce biotin deficiency [2,3,7]. Biotin deficiency has also in the past been linked to sudden infant death [2].

Symptoms of biotin deficiency include reduced growth and impaired reproductive performance, as well as dermatitis [4]. However, clinical signs alone are often insufficient to distinguish the symptoms caused by a deficiency of biotin from those caused by deficiency of pantothenate or zinc [4,7]. Biochemical means must thus be used to assess biotin status in cases of suspected deficiency of the vitamin [4]. However, the diagnosis is seldom made due to the relative un-availability of laboratory methods for the assessment of biotin deficiency.

Activation assays of biotin-dependent carboxylases have been reported for both erythrocytes [4,2,7] and lymphocytes [6]. In the method now being used at Biolab, red cell pyruvate carboxylase activity is measured in patients' samples before and after the addition of excess biotin. An activation index is then reported as a functional, intracellular test of biotin status. This test is more specific and sensitive than the measurement of plasma hydroxyisovaleric acid, which it replaces.

Synonyms

Biotin, coenzyme R, vitamin H.

Patient preparation

No special preparation is required but the patient should refrain from taking nutritional supplements containing biotin for at least 24 hours before the collection of the sample.

Specimen requirements

The sample required for functional biotin measurement is a lithium heparin (green top) tube.

Postal samples must reach Biolab within 24 hours of collection.

Price: £67.00

Methodology

Pyruvate carboxylase is measured in erythrocyte lysates by means of linked enzyme reactions; the decrease in absorbance from oxidation of NADH is monitored [8]. The pyruvate carboxylase activity of the erythrocyte lysates is then re-measured after incubation of the sample with excess biotin.

This method replaces the one previously used at Biolab.

Turn around time

2-3 working days.

Interpretation

The Biolab reference interval for red cell pyruvate carboxylase activation (biotin status) is ≤ 1.05 . A result of > 1.10 indicates biotin deficiency, while activation between 1.06 – 1.10 suggests borderline biotin status.

References

1. Sealey WM, Teague AM, Stratton SL et al. Smoking accelerates biotin catabolism in women. *Am J Clin Nutr* 2004;80:932-935
2. Bender DA. Optimum nutrition: thiamine, biotin and pantothenate. *Proc Nutr Soc* 1999;58:427-433
3. Watanabe T, Oguchi K, Ebara S et al. Measurement of 3-hydroxyisovaleric acid in urine of biotin-deficient infants and mice by HPLC. *J Nutr* 2005;135:615-618
4. Whitehead CC. The assessment of biotin status in man and animals. *Proc Nutr Soc* 1981; 40:165-172
5. Báez-Saldaña A, Zendejas-Ruiz I, Revilla-Monlave C et al. Effects of biotin on pyruvate carboxylase, acetyl-CoA carboxylase, propionyl-CoA carboxylase, and markers for glucose and lipid homeostasis in type 2 diabetic patients and nondiabetic subjects. *Am J Clin Nutr* 2004;79:238—243
6. Stratton SL, Bogusiewicz A, Mock MM. Lymphocyte propionyl-CoA carboxylase and its activation by biotin are sensitive indicators of marginal biotin deficiency in humans. *Am J Clin Nutr* 2006;84:384-388
7. Bitsch R, Tôth-Dersi A, Howetzel D. Biotin deficiency and biotin supply. *Ann N Y Acad Sci* 1985;447:133-139
8. Warren GB, Tipton KF. Pig liver pyruvate carboxylase. Purification, properties and cation specificity. *Biochem J* 1974;139:297-310

Suggested further reading

Bender DA, *Nutritional Biochemistry of the Vitamins*, 2nd Ed., Cambridge University Press, 2003.