# 14. Biotin

## Physiology and metabolism

Biotin functions as the coenzyme transferring carbon dioxide in four reactions: pyruvate carboxylase, a key step in gluconeogenesis; acetyl CoA carboxylase, the first step of fatty acid synthesis; and in propionyl CoA and methylcrotonyl CoA carboxylases [1].

Most biotin in foods is present as biocytin, covalently bound to enzymes. This is released on proteolysis, and hydrolysed by biotinidase in the pancreatic juice and intestinal mucosal secretions to yield the free vitamin. The extent to which bound biotin in foods is biologically available is not known. Biotin is absorbed from the upper intestinal tract by active transport, although there is also some active uptake from the large intestine. Intestinal bacteria synthesise relatively large amounts of biotin, and it is assumed that this contributes to the host's nutrition. Biotin circulates in the bloodstream both free and tightly bound to a serum glycoprotein. Both free and protein-bound biotin are taken up by tissues. In tissues biotin is incorporated covalently into biotin-dependent enzymes, and on catabolism of these enzymes, the biocytin is hydrolysed by a specific peptidase, biotinidase, permitting reutilisation.

Biotin may be excreted either unchanged or as the oxidation production bis-norbiotin. As a result of both resorption of the vitamin from urine and the protein binding of plasma biotin, which reduces excretion, there is very efficient conservation of biotin. This, together with the recycling of biotin released by the catabolism of enzymes, may be as important as intestinal bacterial synthesis of the vitamin in explaining the scarcity of biotin deficiency. There is no information on body reserves of biotin.

## Deficiency

Biotin deficiency due to simple inadequacy of intake is unknown except in patients receiving total parenteral nutrition.

The activities of biotin-dependent enzymes fall in deficiency. This results in impaired gluconeogenesis, with accumulation of lactate, pyruvate and alanine, and impaired lipogenesis, with accumulation of acetyl CoA, resulting in ketosis. There is also an impairment of protein synthesis. Abnormal organic acids are excreted in deficiency [2].

The few early reports of human biotin deficiency are all of people who consumed large amounts of uncooked eggs, and therefore had a high intake of the protein avidin, which binds biotin and renders it unavailable. They developed a fine scaly dermatitis and hair loss. Provision of biotin supplements of between 200–1000 µg/day resulted in cure of the skin lesions, and regrowth of hair, despite continuing the abnormal diet providing large amounts of avidin. Unfortunately, there seem to have been no studies of provision of modest doses of biotin to such patients, and none in which their high intake of uncooked eggs was either replaced by an equivalent intake of cooked eggs (in which avidin has been denatured by heat, and the yolks of which are a good source of biotin) or continued unchanged, so there is no information from these case reports of the amounts of biotin which are required for normal health.

In experimental studies of biotin depletion, diets providing up to 30% of energy intake from raw egg white have been used. The subjects developed glossitis, anorexia, nausea, hallucinations, depression and somnolence, as well as a fine scaly desquamating dermatitis. Injection of 150 µg biotin daily reversed all the clinical signs. Again there have been no studies of graded intakes of biotin in such experiments [3,4].

Similar signs of biotin deficiency have been observed in patients receiving total parenteral nutrition for prolonged periods, e.g. after resection of the gut. The signs resolve following the provision of biotin, but there have been no studies of the amounts required; curative intakes have ranged between 60 and 200 µg/day [5].

## Requirements

There is little information concerning human biotin requirements, and no evidence on which to base recommendations. Average intakes of biotin in the EC are around 28-42 µg /day, but individuals may consume between 15 and 100 µg/d. Such intakes are obviously adequate to prevent deficiency. There is no evidence of adverse effects from high intakes of biotin.

There is no information on which to base estimates on additional requirements in pregnancy or lactation.

## Summary

Average intakes of biotin are adequate to meet requirements. There is no information on intakes below which deficiency is likely, nor adequate evidence to determine the Population Reference Intakes.

The acceptable range of intakes for adults is the observed range 15-100 µg /day.

## References

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