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Significance of Riboflavin (Vitamin-B2) for Health

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Abstract:
Riboflavin, also known as vitamin B_2, is the vitamin formerly known as G. It is an easily absorbed colored micronutrient with a key role in maintaining health in humans and other animals. Riboflavin is the central component of the cofactors FAD and FMN, and is therefore required by all flavoproteins. As such, vitamin B_2 is required for a wide variety of cellular processes. It plays a key role in energy metabolism, and for the metabolism of fats, ketone bodies,carbohydrates, and proteins.The name "riboflavin" comes from "ribose" (the sugar whose reduced form,ribitol, forms part of its structure) and "flavin", the ring-moiety which imparts the yellow color to the oxidized molecule (from Latin *flavus*, "yellow"). The reduced form, which occurs in metabolism along with the oxidized form, is colorless. Flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD) function as cofactors for a wide variety of oxidative enzymes and remain bound to the enzymes during the oxidation-reduction reactions. Flavins can act as oxidizing agents because of their ability to accept a pair of hydrogen atoms. Reduction of isoalloxazine ring (FAD, FMN oxidized form) yields the reduced forms of the flavoproteins ($FMNH_2$ and $FADH_2$). Current interest is focused on the role that riboflavin plays a role determining circulating concentrations of homocysteine, a risk factor for cardiovascular disease. Other mechanisms have been proposed for a protective role of riboflavin in ischemia reperfusion injury; this requires further study.

Keywords: FMN,FAD,Flavoproteins,Homocysteine,Ischemia perfusion injury.

INTRODUCTION:

A small amount of riboflavin is found in foods as free riboflavin, which is an isoalloxazine ring bound to a ribitol side chain; mostly is present as the derivative FAD, and a smaller amount occurs as the monophosphorylated form, FMN. FAD and FMN occur predominantly in a non-covalently bound form to enzymes; flavins which are covalently bound do not appear to be available for absorption (1). Absorption of riboflavin takes place mostly in the proximal small intestine through an active, carrier-mediated, saturable transport process (2).The flavocoenzymes such as FMN and FAD comprise the major part of riboflavin in blood plasma(3) The bioactive forms of riboflavin are hydrolyzed to riboflavin before they enter into the cells, but riboflavin is accumulated in tisues by resynthesis of flavocoenzymes (4,5). In the circulation, glomerular filteration of the vitamin is decreased by binding to plasma proteins (6). There is small additional absorption of riboflavin in amounts (7). Urinary excretion increases linearly with increasing intakes in riboflavin-replete subjects, with an absorption half-life of 1.1 h (7). Initially, free riboflavin is taken up into the enterocytes and undergoes ATP-dependent phosphorylation which is catalyzed by cytosolic flavokinase (EC 2.7.1.26) to form the FMN; most of this is further converted to FAD by the FAD-dependent FAD synthetase (EC 2.7.7.2). Nonspecific phosphatases acts on intracellular flavins to permit transport across the basolateral membrane. Riboflavin may enter the plasma from the small intestine as the free form or as FMN. Research has indicated that carrier-mediated absorption of riboflavin in the colon might be more important than previously thought (8)

BIOSYNTHESIS:

The imidazole ring of GTP is opened hydrolytically by under the release of formate accompanied by release of pyrophosphate, which is catalyzed by GTP cyclohydrolase II (9, 10, 11, 12, 13, 14, 15, 16, 17, 18) The enzyme product 2,5-diamino- 6-ribosylamino-4(3H)-pyrimidinone 50 -phosphate) is converted to 5-amino-6-ribitylamino-2,4(1H,3H)-pyrimidinedione 50 -phosphate by two reaction steps, involving the hydrolytic cleavage of the position 2 in amino group of the heterocyclic ring and the reduction of the ribosyl side chain affording the ribityl side chain of the vitamin (19, 16) 50 -Phosphate of structure 5 can not serve as substrate for 6,7-dimethyl-8-ribityllumazine synthase. Hence, the compound must be dephosphorylated prior to further conversion (20, 21) The dephosphorylated 5-amino-6-ribitylamino-2,4(1H,3H)-pyrimidinedione on condensation with 3,4-dihydroxybutanone 4-phosphate by 6,7-dimethyl-8-ribityllumazine synthase (22, 21, 23). The carbohydrate type substrate of that enzyme has been discovered only relatively recently (23, 24). It is formed from the ribulose 5-phosphate by an unusual reaction involving the loss of carbon atom 4 via an intramolecular rearrangement (25) The end step of the biosynthesis of riboflavin is the dismutation of 6,7-dimethyl-8-ribityllumazine catalyzed by the riboflavin synthasee (26, 27, 28, 29).

TRANSPORT:

Free riboflavin are transported in the plasma bound both total albumin and to certain immunoglobulins, which will also bind flavin coenzymes (30). riboflavin binding protein in chicken egg white that is induced by estrogen and essential to fetal survival (31). Further studies in various other species confirmed the presence similar riboflavin binding proteins in the circulation, which have been ascribed various functions, including placental transport (32). Increased plasma binding of riboflavin has been reported in patients with malignancies attributable to an elevation in specific immunoglobulins, which also contribute to riboflavin retention in such patients (33) Almost all riboflavin in tissues is enzyme bound, such as

FAD covalently bound to succinic dehydrogenase (EC 1.3.5.1) (34) Unbounded flavins are relatively very labile and are rapidly hydrolyzed to free riboflavin, which diffuses from cells and is excreted .The intracellular phosphorylation of riboflavin is therefore a form of metabolic trapping key to riboflavin homeostasis (35) Intakes of riboflavin is in excess of tissue requirements are excreted in the urine as riboflavin or other metabolites such as 7-hydroxymethylriboflavin (7--hydroxyriboflavin) and lumiflavin. Some urinary metabolites reflect bacterial activity in the gastrointestinal tract as well (36).

FUNCTIONS AND CONSEQUENCES DURING RIBOFLAVIN DEFICIENCY:

The significance of riboflavin carrier protein to the fetal development has been documented in mice (37) and chickens (31) Riboflavin deficiency, along with deficiency of other vitamins, as been seen in the etiology of cleft lip-palate abnormalities in 2 infants born to a woman with malabsorption syndrome (38),Symptoms of neurodegeneration and peripheral neuropathy have been documented in several studies of riboflavin deficiency in different species. Young, rapidly growing chickens fed a riboflavin-depleted diet developed peripheral nerve demyelination (39, 40) With high-dose riboflavin supplementation, the anemia is resolved quickly and the neurologic and visual abnormalities are resolved over several months. Riboflavin plays a important role in thyroxine metabolism and riboflavin deficiency may also contribute to the physiology of some mental illness (41)

Corneal vascularization and corneal opacity has been described in animals fed diets low in riboflavin. Cataracts have also been described in animals fed riboflavin-deficient diets (42, 43) The importance of riboflavin deficiency in etiology of cataracts in elderly humans is not fully understood (44) More recently, it was found that riboflavin deficiency may be associated with night blindness in some communities and thereby improving riboflavin status might enhance the improvement in night blindness evoked by vitamin A. Riboflavin-dependent photoreceptors identified in the retina are thought to play a role in the process of dark adaptation (44, 45)

Some studies indicate that the riboflavin deficiency increases the risk of cancer at certain sites, whereas others point to a possible attenuating effect of riboflavin in the presence of some carcinogens and a protective effect of deficiency (46, 47) Some epidemiologic studies have shown a relation between oesophageal cancer and the diets low in riboflavin(48–50) High-dose riboflavin supplementation reversed both effects to near-normal values. The supportive protective role of riboflavin in carcinogenesis is the observed that carcinogen binding to DNA is increased in riboflavin-deficient rats (51) Poor riboflavin status has also been indicated as a risk factor for cervical dysplasia, a precursor condition for invasive cervical cancer (52)

CONCLUSION:

Hence it is found that riboflavin which is called as Vitamin b2 plays important role in human metabolism. Therefore subclinical deficiency of riboflavin leads to increased concnteration of plasma homocysteine which directly associates with increasing the risk of cardiovascular disease.

Deficiency of riboflavin also affects vision,causes cancer ,neurodegeneration and peripheral neuropathy.rioflavin also interacts with other B group vitamins such as folate ,cyanocobalamine,pyridoxine. Hence riboflavin is essential for normal metabolism for human being.

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