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Biochemistry of Fat-Soluble Vitamins

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Abstract: Supplements are gathered into two significant classes: macronutrients and micronutrients. Macronutrients are supplements that are required by the body in huge sums while micronutrients are those required by the body in moment sums. Macronutrients like sugars, proteins, and lipids give atoms to the primary and metabolic exercises of the human body, while micronutrients (vitamins and minerals) are fundamental for the body's legitimate working. The requirement for micronutrients relies upon the metabolic exercises just as on the existence pattern of a person. Indeed, even in intrauterine life, the requirement for micronutrients is fundamental for the typical advancement of the baby. Specifically, vitamin D, iodine, iron, and folic corrosive lacks could prompt intrinsic issues or even demise. Human nutrition, as a field of knowledge, had a great impact at the beginning of the twentieth century. From 1912, experiments such as those developed by English biochemist Frederick Hopkins (1861–1947) demonstrated the existence of certain organic substances in food that are essential for health. Hopkins called them ‘accessory food factors. Vitamins are groups of highly complex compounds, organic in nature, present in foodstuffs in traces, essential for normal metabolism and absence of these nutrients cause disorders whereas, resupply of these nutrients can cure the deficiency symptoms. Vitamins are diverse in nature relative to fats, carbohydrates and proteins.

Keywords: Macronutrients, Micronutrients, Sugars, Proteins, Lipids.

Introduction: Vitamins are essential nutrients required for metabolic process but cannot be synthesized by all living organisms. These are organic molecules that are essential micronutrients which means that they are required in small quantities. All types of vitamins, as cannot be synthesized at all or in sufficient amounts, must be obtained from the diet. The term vitamin is derived from a word vitamine, coined by Polish biochemist Casimir Funk in 1912. Till 1935, the only source of vitamins was food, and then the commercial production of vitamins started which was followed by the mass production and marketing of vitamin supplements including multivitamins. Lack of sufficient number of vitamins causes deficiency diseases. Due to this commercial production of tablets of yeast extracts vitamin B complex and semi-synthetic vitamin C gained attention in the general population. Later the commercial production of vitamin

supplements and addition of it to staple food such as flour or milk was mandated by the government. (Bonnie *et.al*, 2007).

Supplements are gathered into two significant classes: macronutrients and micronutrients. Macronutrients are supplements that are required by the body in huge sums while micronutrients are those required by the body in moment sums. Macronutrients like sugars, proteins, and lipids give atoms to the primary and metabolic exercises of the human body, while micronutrients (vitamins and minerals) are fundamental for the body's legitimate working. The requirement for micronutrients relies upon the metabolic exercises just as on the existence pattern of a person. Indeed, even in intrauterine life, the requirement for micronutrients is fundamental for the typical advancement of the baby. Specifically, vitamin D, iodine, iron, and folic corrosive lacks could prompt intrinsic issues or even demise. The day-by-day necessities of these micronutrients are not fixed, albeit numerous logical papers have referenced the day by day required recompense of different nutrients and minerals. Factors like actual exercise, pregnancy, youthfulness, mature age or explicit eating regimens (for example Veggie lover) impact the requirement for micronutrients. Consequently, the assessment of the micronutrients' necessities and the outcomes of micronutrients' insufficiencies are basic to clarify their job in wellbeing and infection. (Akram 2020)

Review of Literature:

Noeliaet.al (2017): Noeliaet.al reported that Human nutrition, as a field of knowledge, had a great impact at the beginning of the twentieth century. From 1912, experiments such as those developed by English biochemist Frederick Hopkins (1861–1947) demonstrated the existence of certain organic substances in food that are essential for health. Hopkins called them ‘accessory food factors. Shortly after those discoveries, the Polish biochemist Casimir Funk (1884–1967) proposed the term ‘vitamins’ to identify the substances previously termed ‘accessory food factors. The etymology of the term vitamin derives from the Latin ‘vita’ (life) and ‘amina’; Funk concluded that these substances were necessary for life and most of them contained an amino group. Thus, in the early sixties, the identification of essential nutrients necessary to support human life and health (macronutrients, micronutrients and trace elements) was almost concluded. In the last half of last century, all vitamins were identified, their chemical structures were determined and natural sources from which vitamins can be obtained were described in detail. The biological role of each vitamin, their connections with several metabolic pathways and human pathologies and their importance in human nutritional processes were also quickly established. Besides, advances in chemical analysis/technologies during the last three decades have provided the tools to produce vitamins in vitro (even at large scale). Consequently, vitamins can be currently obtained by chemical synthesis, by isolation of natural sources (fat-soluble vitamins) or by microbial biotechnology (mainly water-soluble vitamins). Thus, several human pathologies based on vitamins deficiency can be fully eradicated or their prevalence decreases substantially thanks to (i) promotion of good nutrition practices and (ii) use of dietary supplements containing mainly vitamins and trace elements. Even so, malnutrition is still a massive problem, particularly in some geographic regions characterized by poverty, poor nutrition understanding and practices and deficient sanitation and food security.

- 1) **Muhammad et.al (2017):** Muhammad *et.al* reported that vitamins are groups of highly complex compounds, organic in nature, present in foodstuffs in traces, essential for normal metabolism and absence of these nutrients cause disorders whereas, resupply of these nutrients can cure the deficiency symptoms. Vitamins are diverse in nature relative to fats, carbohydrates and proteins. Vitamins are differentiated from other groups by their organic nature, and their classification

depends on chemical nature and function. Very trace amounts of vitamins are needed for growth, development, health and reproduction. Some vitamins are deviant from usual definition and are not always needed to be part of food stuff i.e. ascorbic acid, vitamin D and niacin. Ascorbic acid is synthesized by animals; niacin synthesized from tryptophan amino acid and vitamin D synthesized from UV radiation from sunlight. Therefore, specific species and under certain conditions vitamin D, ascorbic acid and niacin does not fit in the definition of vitamins. So, far as classification of vitamins is concerned, these are divided into two main categories i.e. water-soluble and fat-soluble vitamins. Vitamins of B complex and C are water soluble whereas, vitamin A, D, E, and K are fat soluble. Fat soluble vitamins have association with fats and absorb dietary fats. Absorption of fat-soluble vitamins follows the same mechanics as for absorption of fats. Water soluble vitamins are not associated with fats and rendered unaffected by alterations in fat absorption.

Biochemistry of Fat-Soluble Vitamins:

1) Vitamin A:

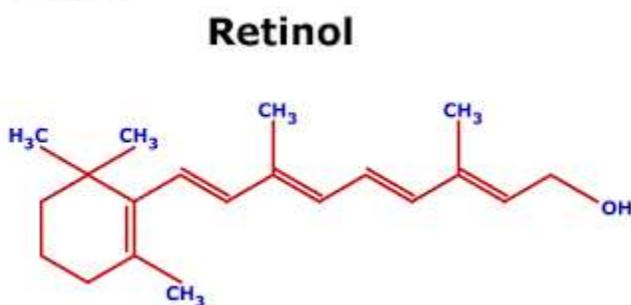


Image 1.1 Source (Internet)

Vitamins A are soluble. The dynamic structure is available just in animal tissues. The provitamin, beta-carotene is available in plant tissues. Beta-carotene has two beta ionone rings. All the mixtures with vitamin A movement are alluded to as retinoids. They have beta-ionone (cyclohexenyl) ring framework. Three unique mixtures with vitamin A movement are retinol (Vitamin A liquor), retinal (Vitamin A aldehyde) and retinoic acid (vitamin A acid) The retinal might be decreased to retinol by retinal reductase. This response is promptly reversible. Retinal is oxidized to retinoic acid, which can't be changed over back to different structures. The side chain contains substitute twofold bonds, and subsequently numerous isomers are conceivable. The all-trans assortment of retinal, likewise called vitamin A1 is generally normal. Vitamin A2 is found in fish oils and has an additional twofold bond in the ring. Organically significant compound is 11-cisretinal.

- 2) **Vitamin D:** Lack in vitamin D can cause delicate, meager, or distorted bones and rickets in youngsters and osteomalacia in grown-ups. It has sufficient vitamin D in the eating routine, notwithstanding calcium, and assists with forestalling osteoporosis. Vitamin D isn't really in its working shape when it enters the body through daylight, food, or enhancements. Notwithstanding acquire vitamin D from a couple of accessible regular and strengthened food sources, the assemblage obviously assimilates nutrient D from daylight. When bright beams hit the skin, creation of nutrient D started soon. Indeed, public get their necessary vitamin D by uncovering their body just a few times in seven days by wearing sunscreen to maintain a strategic distance from expected harm of skin from ultra-infection beams. Nutritionally significant two types of vitamin D are vitamin D2 (ergocalciferol) which is found in plants and nutrient D3

(cholecalciferol) is integrated in the body from cholesterol. Almost 80 % of nutrient D is caught up in small digestive tract and conveyed by proteins in circulation system. Provitamin D (a type of cholesterol) is changed over to vitamin D₃ in the skin. Calcitriol of vitamin D and its chemicals are framed in the liver and kidneys. Satisfactory admission of vitamin D each day is 5 mcg between 19 to 50 years, 10 mcg to 51 to 70 years and 15 mcg more than 70 years mature people. Multiple times harmfulness of Hypervitaminosis of D vitamin for babies, multiple times for grown-ups is profoundly perilous. An individual may require around 5,000-6,000 IUs of vitamin D₃ or all the more consistently, from all sources, incorporates appropriate sun openness, food, or a vitamin D₃ supplement. The ideal reach for most ideal wellbeing is between 50 to 70 mg/ml, and if malignancy or heart illnesses exist, the ideal might be higher.



Image 1.2 (Source-Internet)

- 3) **Vitamin E:** Nuclear family of eight cancer prevention agents and four tocopherols of vitamin E are alpha, beta, gamma and delta, also, four tocotrienols are alpha, beta, gamma and delta out of which Alpha-tocopherols is the most dynamic structure.

Vitamin E is the aggregate name for a gathering of 8 distinct synthetic substances that contain different measures of natural use. Notwithstanding, alpha-tocopherols are demonstrated to cook the necessities of the human body. Vitamin E found in the skin as an essential structure and afterward all out body supplement. The arrival of nutrient E from food requires bile, stomach-related proteins from the pancreas and intestinal plot, and reconciliation into micelles. It is put away in the liver and fat tissue. Its day-by-day necessity is 15 μg each day.

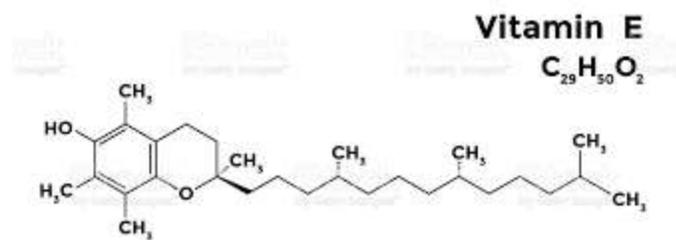


Image 1.3 Source- Internet

- 4) **Vitamin K:**

Vitamin K is named for the German word "koagulation" as a result of its capacity in helping blood clotting. In the twenty-first century its job in forestalling calcification of the veins and other

delicate tissues turned out to be clear. Vitamin K2 is found in creature fats and aged nourishments, in verdant greens and in a lot more modest amounts in many eating regimens when contrasted with vitamin K1. Vitamin K1 all the more viably bolsters blood coagulating, while vitamin K2 is additionally fundamental for building solid bones, forestalling coronary illness, and it has a significant impact in other substantial cycles also. The natural job of vitamin K2 helps to move calcium into the legitimate zones in the body, like bones and teeth and furthermore assists with eliminating calcium from veins and delicate tissues. Vitamin K2 initiates proteins by adding carbon dioxide to them. In this creation of CO₂ by burning-through carbs, working out, and keeping up right degree of thyroid status.

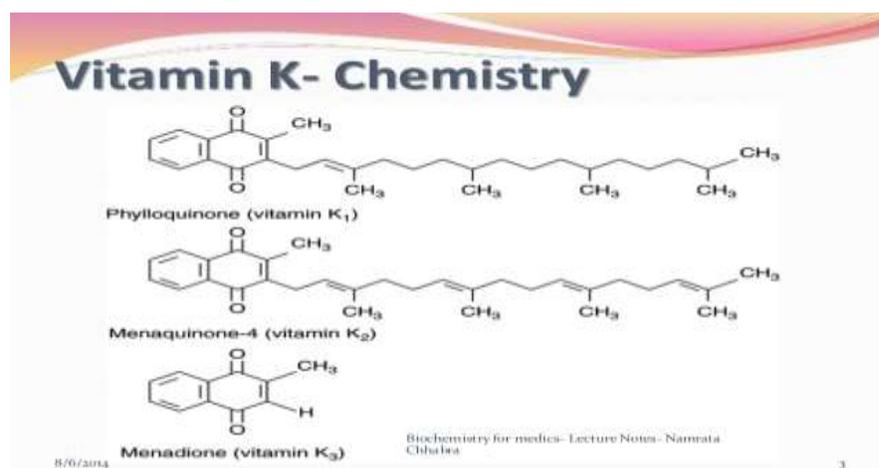


Image 1.4 (Source Internet)

Result and Conclusion: Vitamin A, D, E, and K break up in natural solvents and utilized in rectifying lack illnesses and some used to treat non-lack illnesses which are found in plant and creature sources. Satisfactory admission of fat dissolvable nutrients is exclusively missing among present day people groups particularly by correlation with customary social orders. Normal admission of fat dissolvable nutrients like vitamin A, Vitamins D, nutrient E and vitamin K is insufficient, best-case scenario also, perilously low to say the least even among wellbeing circles. Nutrients can't be delivered by human bodies. They should be eaten through food or as enhancements and they help the body in utilizing food by achieving biochemical responses so life can be kept up. Fat-dissolvable vitamins, whenever devoured in abundance over the proposed portion normally break up in fat and put away in body tissues and the abundance amassing lead to hazardous levels coming about a phase called hyper vitaminosis, which represents abundance store in the body. Most vitamins that are sold as food supplements can't surpass the most extreme everyday measurements. Consequently, able measurement of these greasy nutrients keeps the body working at its ideal limit and a lot of amounts may annihilate the wellbeing harshly. The guidelines of that characterize the restrictions of nutrients measurements for the protected use as food enhancements to upkeep wellbeing and to keep out of conceivable results. Guidelines that characterize cutoff points of fat-soluble vitamin measurements for the protected use as food supplements should be followed to save wellbeing and to turn away results caused by glut. Hence it is felt basic that public mindfulness should be taken up amazingly much of the time. As a nonstop interaction through standard public gatherings, bunch conversations, workshops, hoardings, film slides, notices, society tunes and stage shows identifying with fat soluble vitamin, especially in

niche and corner rustic territories through legislative associations, all things considered, Non-government Organizations (N G O's) corporate medical clinics, edified town gatherings and such.

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