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# Food Microstructure; Its Role In Nutrient Bioavailability

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## Abstract

Food microstructure, a fractional frame work of cellular organelles in plant and animal play a major role in the release and bioavailability of several nutrients and allergenic substances which has great consequences in assessing nutritional role, food impact and nutraceuticals in preventing and as therapy of some chronic human diseases. The awareness and the knowledge of food microstructure is a bed foundation of applied food processing and product development for optimal mucosal and gut absorption and utilization of nutrient in human and animal blood plasmids

**Keywords:** Food microstructure, bioavailability, nutrients and nutrient role.

## Introduction:

The well-being and health of rural and urban consumers are major concerned of modern food processing industry. There has been large scientific evidence linking diseases such as CVD, cancers, diabetes and human immune viral diseases to diet. These diet related diseases are challenging eating habit of people, processing technology approaches and product engineering and development and programmes ( Parada and Aquila 2007).There are many benefit and impaired health effect of food microstructure that influences nutrient in food ( Parada and Aquila 2007).However total amount of nutrient required for dieting could be found in nutritional compositional table but it availability and accessibility by gut mucosal in many cases remains uncertain and varies depending on the nature or state of food (ogori and Utim 2014).processing condition and presence of other component factors .The fraction of nutrient that get to the blood stream of the organism are very important but the availability of the nutrient is being influence by chemical state of the nutrient ,release rate and tendency from the food matrix ,nutrient and interaction ,presence of inhibitors and cofactors ,formation of transition stable and unstable compound that are rate determined based on gut metabolism.( Parada and Aquila 2007).however scientific discovery had shown that certain nutrient state ,matrice condition and microstructure could favour or hinder nutritional responses invivo.The target of this paper is to review in a balance microstructure and food matrix moleculerization and how it could affect bio –avaialability,bio accessibility, bio efficacy and bio –conversion of phyto -chemicals and nutraceuticals in the gut and their presence in the blood plasma.

## Food Microstructure:

Food produced in nature are generally organized from molecule into assemblies or links and organelles, that are later celled and tissue .Food structure could be categorized naturally into fibrous eg muscles, fleshy material eg tubers, fruits and vegetable, encapsulated embryo eg pulse and grains and finally into complex fluid, eg milk .All these categorization are based on cell specialization however forming unique functionality.

Most fruits, vegetable ,meat ,fish ,grains and tubers are eaten around the world with minor or no processing approaches with their edible microstructure being impacted by nature ,however the processed form have multicomponent structure matrices where protein ,carbohydrate ,lipids have been rearranged as either colloidal phase dispersion ,emulsion amorphous or crystalline phases, gel network either by heating ,cooling or by shear forces. This rearrangement could have caused negative or positive deviation of the microstructure resulting in interaction at a low level of 100um( Aquilera and Stanley 1999).Typical microstructural element in food include cell wall starch granules ,protein ,water and oil droplet ,fat crystal gas bubbles ,foams .According to (Cuvelier *et al* 2000) ,molecular structure of food nutrient is the smallest structural level relevant for its biological role and activity during cellular metabolism ,the problem obeys Heisenberg uncertainty principle of time and scale( Kaleb 1995).(Stanly 1991) because the pseudo- plastic flow of food material in the gut varies with time and physiological factors in vivo and



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invitro. Food matrixes implies that nutrient are contain into a lager continuous medium that maybe cellular in origin (fruits and vegetables) microstructure which may interact with each other or media at different scale and time phases. For instance, nutrient maybe found as a molecular bound to an organelle eg Carotenoid in carrot or entrapped in complex macromolecular matrix of starch granules and protein as ligands .Eg Isoflavonones in baked products, isopropyl compound in onion and sulphurhydryl in eggs.

### **Food Microstructure And Nutritional Properties:**

Nutrients are often located in natural cellulosic compartment or in an assembled linkages during processing .In either form, the need to release them during digestion and absorption is a concern. According to (Ellis ,2004).The bioavailability of lipid in almond seed and fecal samples were discovered intact tissue in fecal material using a healthy object in a controlled study after feeding after feeding a subject with an almond rich diet. At the end of the day, almond tissue where found preserved after chewing and digestion. According to (Ellis, 2004), the presence of cell wall hindered the release of intra cellular lipids.

At complete disruption of micro cellular structure, full absorption of certain or particular nutrient may not be certain and could depend on nutrient presence and information with other food constituent. (Brown 1997) discovered that food fiber matric could decrease vitamin A precursor absorption while ferulic acid was favorably absorbed in the presence of brown (Rondini 2004).Food matric has considerable influence on ionic state nutrient bioavailability such as vitamin (Moretti 2006) .The state of food, physical structure, ionic nature, surface area and dilution ration plays bioavailability role in nutrient bioaccessibility, bio efficacy and bioconversion in guts.

### **Nutrient Bioavailability:**

The fractional ingested nutrient that is available for utilization in normal physiological fraction and for storage is termed nutrient bioavailabilty. According to FDA nutrient bioavailability is the rat fraction of absorbed and active available nutrient moiety or therapeutic moieties contain in food or drugs .The concept of bioavailability is made difficult today because of its association with efficiency and metabolic utilization of ingested nutrient ( Gregory, 2005).This could be measured in blood plasma (invivo) but influenced by physiology and individual variability.

### **Nutrient Bioaccessibility:**

This the fractional nutrient released from food matrices and available for mucosal absorption. (Hedren *et al* 2002) defined nutrient availability as the amount of ingested nutrient available for gut absorption .Not all digested nutrient are absorbed therefore bio accessibility could be affected by physical property of the food matric, linking to activity of enzymes and chemical digesting processes (Boyer and Liu 2004)

### **Nutrient Bio Efficacy:**

The fraction of ingested nutrients that has nutrient impact evidence by health state of the individual .Bio efficacy are digested nutrient that may not have nutritional effect so could be cross linked and bounded thereby making them unavailable. Bio efficacy is the fraction of digested nutrient that has nutritional effect evidenced by health.

### **Nutrient Bio-Accessibility:**

Bio accessibility of nutrient can be limited by membrane and fluid transient transport of the nutrient active components. That efficiency of bio- active nutrient could be impacted and this inefficiency could be overcome when food structural matrices is well understood before processing and digestion of food material.

### **Nutrient Bio –Equivalence:**

When there exist no significance difference in the rate and extent to which two or more active ingredient become available at site of active absorption under similar molar does and conditions.



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### **Determination Of Nutrient Bio Availability And Bio Accessibility:**

The methods for determining bio availability and bio accessibility are by human in vivo and invitro experiments. The use of in vivo experiment provides direct data which have been used in great deals on nutrient and foods. Usually response is measured after consumption of pure nutrient over a reference surface point (Nature/synthetic) living organism and compound with equivalent nutritional does found in a food ( Yeum and Russel 2002). Invitro approach is measuring the response from blood plasma concentration over time after meal consumption. The third approach of bio availability determination in blood plasma measurement is after a meal is taken over extended period of days and weeks of constant consumption of a specific food (Van Het Hof et al 1999).

The invitro approach requires no ethical consideration but simulated digestion and absorption for bio availability and bioaccessibility of digestion. All other accessory digesting natural are synthetic practically employed.

### **Bio Availability Of Nutrient For Plant Foods:**

Nutrient bio availability and bio active compounds present in plant products are important. However food microstructure are relevant in bio availability of several anti-oxidant, processing such as grinding, fermentation, ohmic heating may improve bio availability because of cell wall disruption to dissociating nutrient complexes matrices, annealing into more active molecular structure. These could be experience vis a vis during storage and processing of food.

### **Carotenoid:**

Dietary carotenoid is considered beneficial in certain cancers and prevention of varieties of disease. The release of carotenoid from cell wall occurs when cells are disrupted especially using food preparation, processing, masticating and not during digestion.(Zhon et al 1996) assert that food matrices may be pectin like fiber and crystalline carotenoid in carrot chromoplast which is responsible for relative bioavailability of carrot juice incomplete release. The release of B-carotene could be aided by enzymes from spinach Chaya and Macuy, however governed absorption by sublimation in digesta (Serrano et al 2005) (Faulk and southon 2005). Cooked and puree carrot could provide bio availability rich B-carotene for carotenoid rich food.

### **Lycopene:**

Lycopene in a carotenoid in tomatoes characterized by it red colour .Food processing like cooking heating may improve lycopene bio availability. This approach weakens cell structure and bonding angles. Matrixing enhances isomer form of Trans -form of lycopene though a natural cis-form can be available preferably at the chylomicrons. Lycopene moiety are much present in tomato paste than in fresh tomatoes because of microstructure matrixing.

### **Xanthophylls:**

They are the yellow pigment of leaves. They are oxygenated carotenoid synthesized within the plastid. The other forms of Xanthophyll's accumulate in optic region and help in great deals in vision and against oxidative damage. The nutritional pigment can be made available for the blood via Lipid presence. According to (Erdman et al 2002) Xanthophyll bio- availability in a function of its molecular structure and nutrient interaction.

### **Folats:**

Folate is one of B- vitamins required for reproduction and for new cell maintenance. Lack of folat in associated with esophageal, gastric and pancreatic cancers (Larson 2007).Brain depression. (Abon-saleh and copen 2008). Naturally folate are bound to macro molecules and disruption of folat- macro molecules structure make them unavailable for absorption either by entrapment or free unbounded state, hence unavailable , limiting them from being absorbed by absorption surfaces. Food matrixes effect reduces the load of folat absorption issues.



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### **Polyphenols:**

Polyphenol is a conjugated varied compound and classes such as flavonoid, isoflavin, hydroxyl benzoic, anthocyanine (Manach et al 2005). They are usually secondary metabolite of phenyl propanoid pathway in plant that comes by phyto-chemicals. The bio availability of polyphenol is highly variable depending on their structure of bio channels conjugation for example sugar has 0.1% bio availability, anthocyanin in berries and red wine has 1%-5% bio availability. 10%-30% for flavon and 50%-80% isoflavin (Scalbert and Williams et al 2000) Polyphenol being sensitive to alkaline condition in the gut bowel movement concentration moiety in target tissues varied concentration in plant tissue, cell wall structure, location of glycoside and binding matrix (Monash et al 2005) could easily be transformed before absorption (Bermudez solo et al 2007). However pancreatic digestion showed a significant role of bio availability of phenolic compound for grape seed unlike gastric and salivary digestion extract (Lau-rent et al 2007).

### **Matrix Heterogeneity:**

The absorption of high lipophilic food micro constituent such as vitamins, phyto-chemical depends on fat and food matrix types (Borel et al 2003). Studies have shown that the bio availability of heterocyclic aromatic amines from meat depend on meat doneness (Kulp et al 2003). The heterogeneity of food matrix avidly influences bio availability of nutrient depending on the state, nature, concentrate and binding angle of that nutrient within or across the cellular pocket. This calls for understanding food matrix micro structure for developing food products.

### **Conclusion:**

One interesting area in food technology now is nutrient bio availability in the area of applied food science and technology. Though, certain food matrices or cell against degradation attaches themselves to members, occluded organelles or cell bonding but this nature protects lower bio availability. The approach of heating mastication and, digestion does not all release bio active for cellular membrane, when they do phase interaction plays its part, hence creating binding and cross binding to food microstructure, colloidal structure, and chemical complexes that improve or reduce their bio availability. Food micro structure can be manipulated to our advantages by protecting nutrient extract and beneficial during storage and in man-made matrices.

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