

## Potential role of *Citrus* Carotenoids on Human Health

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### Introduction

There are many crucial metabolites present in *Citrus* fruits, carotenoids are one of them; mostly identified in peels and pulps. The carotenoids pigments are C40 isoprenoid with yellow, orange and red in colour [1]. Moreover, till to date more than 600 pigments of carotenoids were reported, in which 115 carotenoids were obtained in *citrus* fruits including  $\beta$ -carotene,  $\alpha$ -carotene, lycopene, lutein,  $\beta$ -cryptoxanthin and others [2]. Multiple studies have reported that consumptions of such carotenoid compounds are essential due to its antioxidant effects which lowers the risk of low density lipoprotein, heart disease, eye disease, as well as in cancer [3]. Further, research evidence suggest that almost 80% of vitamin A consumed by the human body were the consequence conversion of crucial bioactive components such as  $\alpha$  and  $\beta$  carotenes in daily diets to promote human health.

### In vivo metabolism of citrus carotenoids

*Citrus* derived carotenoids are vital components identified in trace amounts in *Citrus* peels and pulps. However, its bioavailability in human body is still infancy and unclear, although its impacts on human health is high. Indeed, the bioavailability of carotenoid components depends on intestinal absorption and metabolism, such metabolites are not easily absorbed in the host body so it passes and dispersed through gastrointestinal tract to the stomach mixing with bile salts, dietary lipids and free fatty acids solubilized in the mixture of micelles [4]. Further, it is absorbed by the intestinal epithelial cells into chylomicra where it released into lymph and then permits to the small intestine [5]. Later, the metabolized components enters to the colon for further degradation uptake of components and excrete out more than 90% via feces [5]. On the other hand, remaining unabsorbed metabolites passes to the liver where retinyl ester forms could be stored and transfer to the portal vein system to release very low density lipoprotein (VLDL), low density lipoprotein (LDL), and highly density lipoprotein (HDL) stored in fat tissues, eye, muscles, skin, and finally excreted out through sweat and urine [6]. In addition, studies reported that BC01 and BC02 enzymes, cyclooxygenase, and lipoxygenase play an important role in the absorption mechanism of carotenoid components such as different types of carotenes and xanthophyll although its bioavailability mechanism is not fully understood till to date.

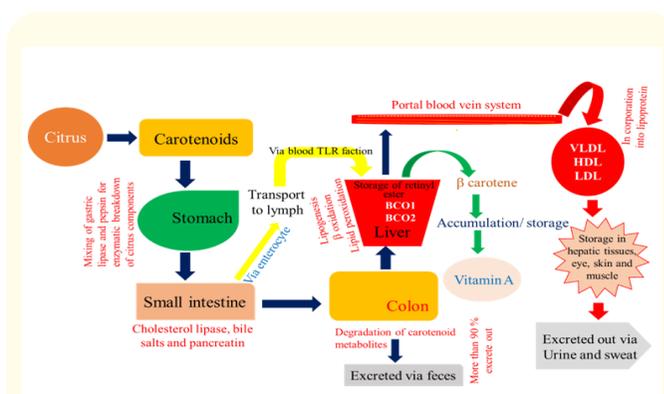


Figure 1: In vivo metabolism of carotenoids metabolites.

### Health promoting effects of citrus carotenoids

It is well documented that carotenoid metabolites shows crucial bioactivities to promote human health. It is proposed as a candidate molecules for the prevention of several diseases including obesity, chronic diseases, and immune enrichment [7,8]. The key unlocking some of the mysteries of carotenoid components such as carotene and lycopene shows inhibition impact against cancerous cells including lung, breast, ovarian, pancreatic and ovarian cancers [9,10]. Moreover, studies reported that lutein and zeaxanthin play an important role for the prevention of eye related diseases and  $\beta$ -carotene were used to lower the risk of osteoporosis [11]. In short, *Citrus* carotenoid metabolites have potential role to promote human health.

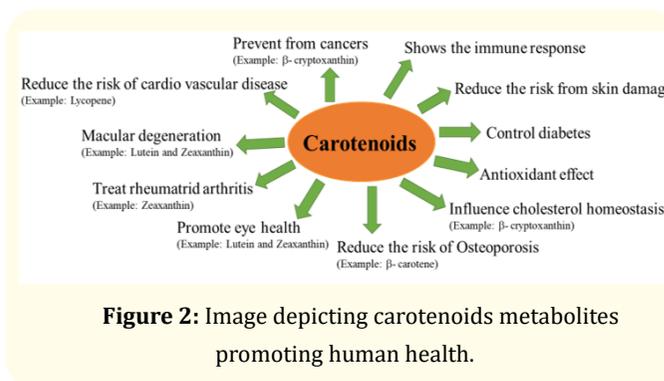


Figure 2: Image depicting carotenoids metabolites promoting human health.

### Conclusion and Future Prospects

*Citrus* fruits are most commonly consumed all over the world due to its bioactive trace functional components such as carot-

enoids, used as nutritional value and other hand as a weapon to reduce the risk of several diseases including metabolic disorders, cancer, cardiovascular diseases, eye related diseases, and boost immune system. Marvelous progress have been done in last couple of decades in this field. However, the clear mechanism of *citrus* carotenoid components bioavailability is still infancy. Therefore, more *in vivo* and clinical studies are required to understand the exact role of particular metabolites to develop scientific based nutritional diet to promote human health.

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