

# DUKU AND CARAMBOLA – A PACK OF BIOACTIVE COMPOUNDS FOR CANCER PREVENTION

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**Abstract:** Cancer is the major cause for increased death rate among the population. Increased load of free radicals and low antioxidant ingestion are the most common etiological factors leading to increased carcinogenic cell proliferation which result in cancer. Some of the traditional fruits are considered as exotic fruits been packed with plenty of nutrients especially anti-oxidants in higher quantity. Duku and carambola are the two among exotic fruits contains functional properties which have been studied for its higher potent of anti-oxidant property. Some of the studies have identified the presence of bioactive compounds like limonoids in Duku fruit whereas pro-anthocyanidins in carambola. These bioactive compounds were proved as natural anti-oxidants that exert delayed oxidative rancidity and inhibit proliferation of carcinogenic cells. Many of the studies have revealed that Duku fruit and carambola have not only respond to cytotoxic effect but also gave positive results for most of the phytochemical screening tests. Other than bioactive compounds, the fruits contain  $\beta$ -carotene, selenium, resveratrol and vitamin C, thereby boosting the Immune system of the body. The seeds and peels of these fruits also possess anti-oxidant property. Hence, instead of discarding the peels and seeds, these can be used as Salad dressing, Soup mixes, Ice-cream-toppings, Fruit juices using pulverized seeds and dried fruit peels. Regular consumption of Duku and carambola fruits may reduce the risk of cancer by supporting the body with antioxidants, thereby reducing the accumulation of free radicals. Hence, the study is a review on two exotic fruits.

**Keywords:** Cancer, Duku, Carambola, Exotic fruits, Antioxidants, Bioactive compounds, Free radicals.

## I. INTRODUCTION

Cancer is the second largest disease-causing death in the world. WHO states Cancer as “a generic term for a large group of diseases that can affect any part of the body”. Cancer can also be defined in Other terms namely malignant tumors and neoplasms. One characteristic feature of cancer is the rapid proliferation of abnormal cells that grow beyond their usual boundaries, which then invade adjoining parts of the body and spread to other organs, the latter process is referred to Metastases. It is a major cause of death from cancer.

According to the recent study conducted by Indian Council of Medical Research (ICMR, 2016), total number of new cases of cancer accounts to about 14.5 lakhs which is likely to reach 17.3 lakh by 2020 in India. Over-production of free radical leads to “oxidative stress” that can be defined as the state of imbalance between the high production of reactive oxygen species (ROS) and the low amount of antioxidant defense systems (Nakahara, K. et.al., 2002).

Epidemiological studies have supported that antioxidants have a role in the prevention of several chronic diseases including cardiovascular disease, cancer and diabetes. Most of the antioxidants are non-enzymatic in nature and are found in foods and supplements. It boosts the human enzymatic antioxidant defense system and prevent the depletion of enzymatic antioxidants (Valko, M. et.al., 2006).

Exotic fruits are rare and uncommon fruits which are not native and are cultivated in other than the native place to make it available to the population. Some of the exotic fruits are tropical. *Lansium domesticum Correa* (Duku fruit) and *Averrhoa carambola* Linn (Star fruit) are the two exotic fruits packed with plenty of nutrients especially antioxidants. *Lansium domesticum Correa* commonly known as Duku fruit serves as an alternative source of natural antioxidant and contains anti-genotoxic substances for the prophylaxis of free radical-related diseases. The peels of *Lansium domesticum Correa* were reported to have large constituents of triterpenoids and phenolic compounds such as flavonoids (Intan Syahira Ramli and Shajarahtunnur Jamil, 2015).

*Averrhoa carambola* Linn fruit is a rich source of natural antioxidants and contains polyphenolics as its main antioxidants. The antioxidants present in it suppresses the production of active species of hydroperoxides and hydrogen peroxide thereby scavenging active free radicals causing cancer (Sindhu Nettem et.al., 2013). Some of the study reveals that Duku fruit and carambola fruit contains bioactive compounds that prevent the occurrence of cancer. The study discusses on the review of exotic fruits and its Cytotoxic effect.

## II. DUKU FRUIT

### 2.1. Origin and Nature

*Lansium domesticum Correa* is one among the common fruits consumed by the people of Thailand, which is known in Thai as “long-kong”. It belongs to the Meliaceae family and are very popular in Thailand and surrounding countries in Southeast Asia. It has different names in different regions like in Indonesia, it is known mainly as langsat, duku, or kokosan while in Malaysia it is known as langsat, lansa, langseh, or langsep and in Philippines as lansones (Tilaar, M. et.al., 2008).

The well-known and economic fruit develops between 15 and 25 fruits per bunch with little non-sticky sap on the skin. The appearance of long-kong fruit is globular in shape with an average size of 1.2–2.4 inches in diameter, contains 1 to 5 seeds of 18 mm length each in one fruit. The skin peels easily and cleanly from the flesh. The flesh of the fruit is white, translucent and juicy. The flavor varies from sweet to sour and

tastes very delicate and sweet. It has a brittle and rough skin with five segments of white translucent flesh surrounds the seed. (Figure 1 gives the illustration of the whole fruit).

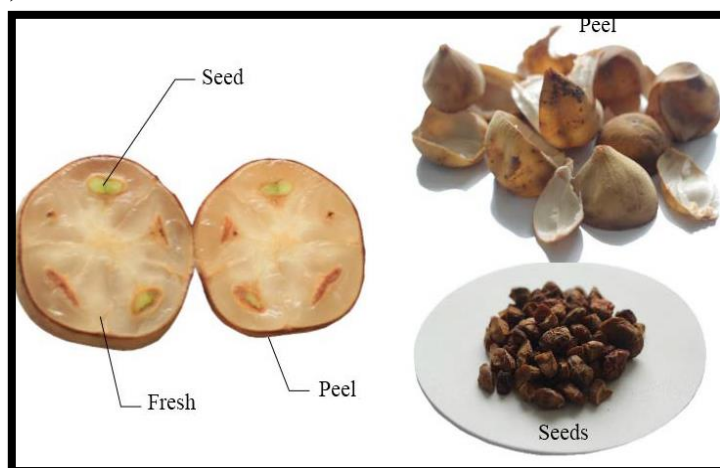


Figure 1: Illustration of Duku fruit's flesh, seeds and peel

## 2.2. Nutritional Benefits

The nutritional composition of duku fruit per 100 grams contains 70-74 calories, 1.0-1.5 g protein, 0.2-0.5 g fat, 13-15 g carbohydrates, 0.7-1.0 g minerals, 18-20 mg calcium, 9-11 g phosphorus and 0.9-1.5 mg of iron. The composition of minerals and calories are found to be higher than imported fruits like apples and oranges (Mabberley, D. 1985). The fruit is relatively high in dietary fiber, which benefits the digestive system by preventing colon cancer and act to cleanse the body from cancer-causing free radicals. In addition to the fleshy portion of the fruit, peel and seeds are beneficial to reduce fever and also act as anti-diarrheal medicine. *Lansium domesticum correa* is also known for its antimalarial, antimicrobial, anticancer and antibacterial properties. Traditionally, the barks of the tree are often used to treat venomous insect bites, dysentery medicine and eradicate cancer cells (Norhayati, AH. et.al., 2016).

## 2.3. Phytochemistry

Phytochemical test answered positive for the presence of terpenoids in seeds of the fruit. Germacrene-D is found in abundant amount in the fruit. Limonene,  $\alpha$ -cubebene, 3-carene, isodene,  $\alpha$ -cardinol,  $\beta$ -panasinsene,  $\alpha$ -calacorene were found in duku fruits. The seed extract was found to be a rich source limonoids (Sueli Rodrigues et.al., 2018). These phytochemical compounds are reported to scavenge the free radicals formed in the body thereby preventing the occurrence of cancer.

## 2.4. Bioactivity of Duku fruit

The duku fruit was found to exert antioxidant, antibacterial, anti-tumour, skin whitening, antimicrobial, anti-plasmodial, cytotoxic and anti-leukotriene activity. Most of the studies reported that the antioxidant activity of the duku fruit is common and are well-known. The antioxidant property of Duku fruit was found to be beneficial in morphological changes of human colorectal adenocarcinoma cells lines (HT-29) reported by studies. The duku fruit extract was found to inhibit the proliferation of human colorectal adenocarcinoma cell lines (Rohin Mohd Adzim Khalili, 2017). Some of the studies had revealed that the presence of limonoids exerts cytotoxic effect against cancer cells. Above the antioxidative effect, the flavonoids present, stimulates the antioxidative enzymes to inhibit carcinogenic cell proliferation. Also found to have anti-mutagenic, anti-thrombotic, anti-inflammatory, and anti-apoptic effect (Choi, Y.M. et.al., 2006).

Some of the studies reported that the fresh peel of the fruit contains 0.2% of a light-yellow volatile oil, a brown resin and reducing acids. Five tetranorterpene, domesticulide A-E (1-5), were isolated from seed of *Lansium domesticum Correa* together with 11 triterpenoids. The seed extract of *Lansium domesticum Correa* is a rich source of limonoids. Six classes of the limonoids have been isolated from the fruit, includes andirobin derivatives, methyl angolensates, mexicanolides, an azadiradione, onoceranoids and dukunolides (Willcox, J.K. et.al., 2004). The limonoids are anti-cancerous in nature and protects body from many cancer-causing elements.

Some organic acids were isolated from fruits including malic, citric, ascorbic and piroglutamic acids. The malic and citric acids are the main organic acids in fruit with the concentration (%) of 0.386 and 0.180. The pH of duku is 4.56 with total titratable acid of 0.503 percent (Julius Pontoh. et.al., 2015). It contains many powerful antioxidants that fight against free radical which damages the cells. Oxidative damage to cells leads to formation of malignant tumors and cancers. Duku fruit has beneficial effects in human health which includes enhancement of RBC formation, contains vitamin-A acting as a cofactor for vital body functions, the extract was also used in the treatment of diarrhea with positive results (Manosroi, A. et.al., 2012).

A study reported that the peel of *Lansium domesticum Correa* fruit was found with higher  $O_2$  and  $OH$  scavenging activity than the seeds, while extraction was done with 50% aqueous ethanol and partitioned with ethyl acetate (LDSK50-EA). It had a geno-protective effect by reduction of the DNA damage induced by  $H_2O_2$  radicals, proven by comet assay in TK6 cells. The study generated a new pathway to a discovery of alternative source of natural antioxidant and anti-genotoxic substances for treatment of free radical-related diseases as well as for the development of nutraceutical industry (Prapaipat Klungsupya. et.al., 2015).

### III. CARAMBOLA FRUIT

#### 3.1. Origin and Nature

*Averrhoa carambola* Linn belongs to Oxalidaceae family. The fruit is well known for its peculiar star shape hence, commonly known as Starfruit, an age-old plant. It is a tropical fruit with a mixture of sweet and sour flavor. It was originated in Ceylon and the Moluccas, but has been cultivated in Southeast Asia and Malaysia for many years. It is commonly available in Sri Lanka, Southern China, Taiwan, Philippines, Queensland, Australia, Malaysia, Thailand, Israel, Florida, Brazil, Indonesia, in some of the South Pacific islands, particularly Tahiti.

In India, it is commonly found in warmer regions like southern states and along the west coast and extends from Kerala up to West Bengal. The fruit is about 2 to 6 inches in length. Here exist two distinct classes of Carambola, the Smaller with sour taste and the Larger with sweet taste. The word carambola originates from a Sanskrit word "Karmaranga" meaning "food appetizer" (Kumar Hitesh and Arora Tejpal, 2016). The Starfruit believed to thrive up to 4,000 feet which accounts to about 1,200 m. When small, the fruit is green in color but when ripe it turns yellow. It is fleshy, five lobed, ovate to ellipsoid ranging from 5 – 8 cm long and 9 cm wider. It stays fragile and are susceptible to wind scarring when grows on tree. The fruit is crunchy with slight acidic and sweet taste and very juicy in nature (Gheewala Payal et.al, 2012). (Figure 2. Illustrates the carambola fruit).



Figure 2. Illustration of Carambola fruit

#### 3.2. Nutritional Benefits

The nutrient composition of the carambola fruit per 100 g contains 35.7 Calories, 92% Water, 89000-91000 mg Moisture, 380 mg Protein, 80 mg Fat, 0.32-16.5 mg Iron, 9380 mg Carbohydrate, 34 mg Vitamin C, 61 IU Vitamin A and 0.80-0.90 of Fiber. The *Averrhoa carambola* Linn fruit were reported to exert Antioxidant, Anti-inflammatory, Hypoglycemic, Anti-ulcer and Anti-microbial activity. The fruits were used to treat throat inflammation, jaundice, ascites, food poisoning, diarrhea (Thomas, S. 2008). Other beneficial effects include weight loss due to high fiber content, the flowers were believed to treat cough. Starfruit is a very good source of vitamin B9 (folic acid), which helps to reduce the risk of heart disease and stroke. Starfruit contain B-complex vitamins, which are essential for strong and health hair growth (Chung, KS. Paul, PH. Kimura, T. 1998).

#### 3.3. Phytochemistry

Phytochemicals present in the fruit are Saponins, Alkaloids, Flavonoids Proanthocyanidins, epicatechin, Gallic acid in gallotannin form, Sterol compounds include  $\beta$ -sitosterol, camp sterol, lupeol and isofucosterol, Fatty acids include - Palmitic, oleic, linoleic and linolenic acid and Minerals like Iron, Calcium, Phosphorous in edible portion of the fruit. The fruit also contains Flavones namely Apigenin-6-C- $\beta$ -L-fucopyranoside and apigenin-6-C- $\beta$ -1-fucopyranoside along with some tannins (Mia Masum, Md, 2007). A study reported that *Averrhoa carambola* Linn answered positive results for all the phytochemical screening tests like Terpenoids, Flavonoids, Steroids, Saponin, Alkaloid and Tannin. The fruit was found to have higher antioxidant content due to the presence of high phenolic compounds (Noor Asna, A and Noriham, A, 2014).

#### 3.4. Bioactivity of Carambola fruit

Both the peels and fruit were found to have significant antioxidant property. But a study has concluded that, the peels of the fruit is said exert more antioxidant property than the fruit or the pulp. The antioxidant content was believed to increase significantly as the fruit ripens or mature (Lim and Lee. et.al., 2013). The current study also demonstrated that the star fruit peel contained a higher antioxidant capacity than pulp. A study had reported that peel extract gave a remarkable effect in protecting cell from oxidative damage due to the additional phenolic compounds present in peel than juice and pulp residue. Similar findings were reported on fruits, such as pomegranate, plum, nectarines, apple and mango (Kim, H. et.al., 2010).

On a preliminary study, the supplementation of star fruit juice was given twice daily for a period of one month to elderly subjects, showed significant inhibition of release of proinflammatory cytokines such as tumor necrosis factor- $\alpha$  and interleukin-23. After 4 weeks of regular consumption of carambola fruit juice, the plasma concentration of Vitamin – A, C were increased markedly to notify that the fruit is beneficial



for health. The antioxidants present in the fruit helps not only in delaying oxidative damage but also scavenge more free radicals and showed a significant control on High Density Lipoproteins being decreased (**Jirakrit Leelarungrayub, 2016**).

A study reported that polyphenolics present in the fruit were identified by Liquid chromatography and mass spectrometry, where the peaks characterized as L-ascorbic acid, Gallic acid as Gallotannin and epicatechin, which are the bioactive compounds that helps in scavenging of free radicals thereby preventing cancer (**Shui, G. and Leong, LP, 2006**). The antioxidant activity was not only exerted by the fruit but also by the stem. Hence, the whole fruit and extract of the fruit can be consumed for its additional and effective role in cancer prevention (**Tadros, SH. and Sleem, AA, 2004**).

#### IV. CONCLUSION

*Lansium domesticum* Correa and *Averrhoa carambola* Linn are the two exotic fruits packed with plenty of nutrients and bioactive compounds that exerts potential benefits to human beings. The fruits were studied for its antioxidant property and its role in cancer prevention. Besides being an antioxidant, it also serves as an alternative source of pharmaceuticals. These fruits can either be consumed as whole or taken as juices to avail its benefits. From the above studies, it is well-known that even the crude extracts of the fruit contain antioxidants and phytochemicals that have the tendency to scavenge free radicals thereby preventing cancer. Further studies are desired on formulation of nutrient drink using these exotic fruits for commercial sectors.

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