The Green Coconut Water as the Most Nutritious Natural Drink: A Review

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***Abstract*—Green coconut water is a refreshing, isotonic drink with electrolytes similar to human plasma. Rich in nutrients, it boosts metabolism and immunity. Cytokinins are most important constituents and may offer anti-cancer benefits. As its medicinal value is recognized, coconut water is becoming popular among athletes and health enthusiasts, particularly in developed countries. This rising demand presents a valuable opportunity for small-scale Asian farmers. Its balanced mineral and sugar content also makes it an appealing natural sports drink.**

***Index Terms*— Coconut water, cytokinins, isotonic drink, vitamins.**

I. INTRODUCTION

Coconut water is obtained from the inside of a young coconut as a translucent or semi-clear liquid enriched with sodium, potassium, magnesium, vitamins, lipids, amino acids, enzymes, phytohormones *etc*. [1]. The green coconut water is extensively used as drink in whole world from ancient times to present owing to its versatile health benefits like oral rehydration, treatment of childhood diarrhea, gastroenteritis and cholera [2], helps to synthesis of protein from recombinant DNA vectors [3], reduce blood pressure [4] etc.. It also protect Cancer, maintain sugar level for diabetic patient, increase the efficiency of digestive system, decreases constipation and cholesterol, increases blood circulation, sustains the good immune system, avoids blood clotting, repairs the skin's strength and elasticity, reduces wrinkle [5-7]. Coconut water facilitates the breakdown of kidney stones by thinning urine; thereby make possible the removal of various chemicals from the kidneys, such as calcium, phosphates, uric acid, etc. from the body [8].

G. K. Darbha et. al investigated the human health risk of potentially toxic elements in soil, groundwater, and their uptake by Cocos nucifera in arsenic-contaminated environments and concluded that coconut water is free from traces of harmful, potentially toxic elements (PTEs). "The coconuts seemed to act as a natural filter, preventing these toxic elements from entering the core of the fruit itself" [9]. Cn-AMP2 (TESYFVFSVGM), an anionic host defence peptide obtained from green coconut water, exhibited significant anti-proliferative effects against the 1321N1 and U87MG human glioma cell lines, with IC_{50} values of 1.25 mM and 1.85 mM, respectively. Structural analysis revealed that the membrane-interacting form of the peptide adopts an extended conformation, characterized by predominantly β-type structures (>45%) and random coil architecture (>45%). These findings suggest that the short anionic N-terminal sequence (TES) of Cn-AMP2 interacts with positively charged components on the cancer cell membrane. Simultaneously, the long hydrophobic C-terminal sequence (YFVFSVGM) facilitates penetration into the membrane's core region, enabling Cn-AMP2 to translocation across the cancer cell membrane. This mechanism ultimately targets intracellular processes, thereby inducing anti-proliferative effects [10]

II. CHEMICAL COMPOSITION AND THEIR USES

Coocnut water contains phytohormones like auxins, cytokinins, gibberlins, and Abscisic acid (ABA), which function as plant growth regulators. It is enriched with minerals for electrolyte balance like potassium, sodium, magnesium, phosphorus, calcium etc. and other components like vitamins, sugars, etc. [11]. The complete composition provides a lot of health benefits.

2.1 Auxin

Coconut water consists of primary auxin in plants, indole-3-acetic acid (IAA), which is responsible for regulating various physiological processes like relay

of environmental signals including light and gravity, cell division, fruit development, root induction from cuttings, leaf shedding, make possible the stem elongation, slow down lateral bud proliferation, and upholding apical dominance via the stimulation of cell elongation within the apical meristem in plants [12-14]. IAA is a weak acid (pKa = 4.75) [Fig. 1] and is synthesized in the meristematic regions at the shoot apex and then transported to the root tip [15].

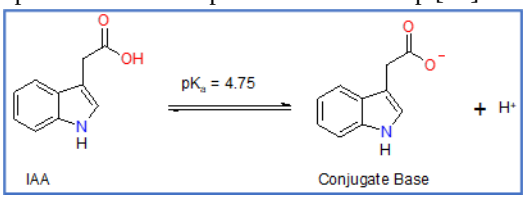

Fig 1. : Ionization equilibrium of IAA

IAA, in its free form or conjugated form can be used in different amino acids, peptides, and carbohydrates [16].

2.2 Abscisic acid (ABA)

It is also present in coconut water as another phytohormone. It is stress hormone and governs stress-related reactions. In addition it inhibits growth as per requirement by the plants to adopt the unfavorable environment [17]. ABA has potential effect human health at central nervous system (CNS). As well as plant, it acts as stress hormone in human body. It is an alternative natural therapy for the sleep disorder. ABA also improves the memory in mammals, elicit antinociceptive effects and reduces neuropathic pain at spinal cord level [18].

2.3 Gibberlins (GBs)

Gibberlins are a variety of phytohormones those are present in coconut water. It regulate the plant growth and and development with respect seed germination, epidermal cell elongation, leaf expansion and flower development. In addition, gibberellins derivatives have anti-tumor bioactivities [11,19]

2.4 Cytokinins (CKs):

Natural cytokinins are N6-substituted adenine derivatives with different substituted groups, and their physicochemical activity is affected by side chains, sugar, phosphate, and the degree of purine ring and or side chain modification [20-22]. Coconut water contains cytokinins, which are hormones that assist in the growth of plants. Cytokinins are phytohormones or plant hormones that control a plant's growth, development, and ageing.

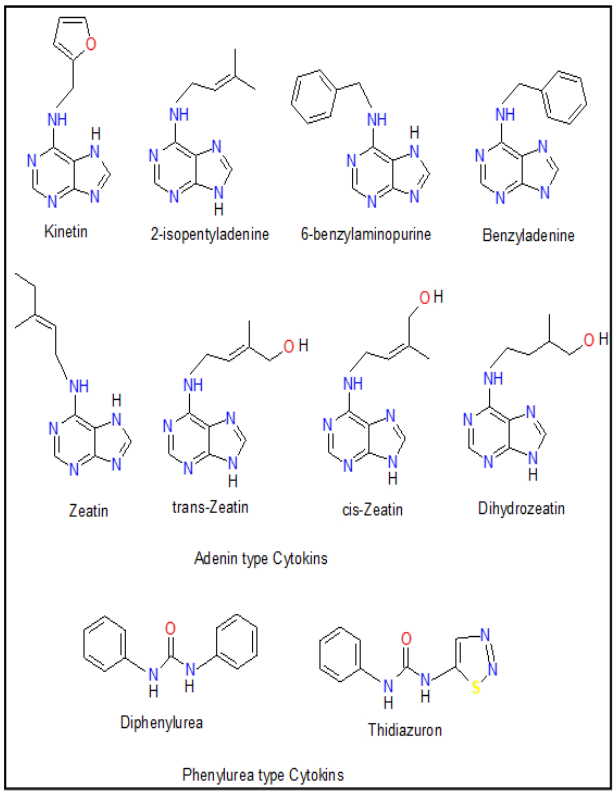

Fig. 2: Structure of Cytokins

CKs are extensive signaling hormones from plants to humans with high medical potential. Coconut water contains various cytokinins out of which kinetin, *trans*-zeatin and their derivatives are known to possess medicinal values. These have antioxidant activity, anti-aging activity, anticancer activity, neuroprotective activity, anti-inflammatory and immunomodulatory effects [23].

2.5 Vitamins

Human body required vitamins for its normal functions. Intake of necessitate amount of vitamins will reduced risk of cardiovascular disease, stroke, and cancers of the mouth, pharynx, esophagus, lungs, stomach, and colon which may be achieved by the greater consumption of fruits and vegetables. Coconut water is one of the vital natural sources of these vitamins like B_1, B_2, B_3, B_5, B_6, B_7 and B_9 [24].

2.6 Minerals:

Coconut water is rich in electrolytes; essential minerals that help maintain hydration. The body loses

water and electrolytes through sweating during exercise or physical labour, as well as during illnesses like diarrhea.

2.6.1 Sodium:

Sodium, the most essential positive ion inside and outside human cells, plays a key role in maintaining hydration. It is lost from the body through sweat and urine [25]

2.6.2 Potassium:

Coconut water contains significantly higher levels of potassium compared to other electrolytes. Potassium, a vital positive ion (cation) within cells, helps maintain cellular function. However, an imbalance in potassium levels can have serious effects: **hyperkalemia**, or excess potassium in the blood, can lead to an irregular heartbeat, temporary paralysis, and tingling in the hands and feet, while **hypokalemia**, or low potassium levels, can also disrupt normal body functions [25]

2.6.3 Magnesium:

Magnesium plays a crucial role in transmitting electrical impulses in body cells and facilitating potassium movement for muscle contraction and relaxation. It also supports energy production and promotes proper organ function. Intense exercise can deplete magnesium levels, increasing the risk of muscle cramps, spasms, and restlessness [25]

2.6.4 Phosphorous:

It is essential for maintaining bone health, transmitting energy throughout the body, supporting muscle contraction, and regulating nerve function [25]

2.6.5 Calcium:

It plays a vital role in facilitating muscle contraction and function, as well as transmitting electrical impulses between body cells. Beyond supporting healthy bones and teeth, calcium is crucial for numerous bodily functions [25].

2.6.6 Iron:

It is essential for various cellular functions, including the production of hemoglobin, which plays a critical role in oxygen transport. It also supports the conversion of blood sugar into energy and aids cells in utilizing oxygen efficiently [26].

2.6.7 Sugar:

The water in the endosperm contains sugars such as sucrose, glucose, and fructose, which act as energy sources in the body's metabolism. The concentration of these sugars, particularly sucrose, increases with the maturity of the coconut [27].

2.6.8 Copper:

It is a vital metal ion found in all tissues of the body, serving as a cofactor for numerous enzymes essential for proper bodily function. It supports processes such as cellular respiration, peptide production, neurotransmitter biosynthesis, and pigment formation. Additionally, copper may help manage conditions like aceruloplasminemia, Alzheimer's disease, and Huntington's disease [28].

2.6.9 Chlorides:

Chloride (Cl^-) plays a key role in maintaining normal fluid balance in the body. It combines with hydrogen ions to form hydrochloric acid (HCl), which is essential for the proper functioning of the gastrointestinal tract. Chloride, along with bicarbonate (HCO_3^-), helps regulate blood pH and supports the maintenance of blood volume and pressure [29].

2.7 Amino acids:

Amino acids are crucial for tissue repair and are abundant in coconut water, including alanine, arginine, cysteine, and serine. Arginine, in particular, supports the body's stress response and promotes heart health. Tender coconut water also contains trace amounts of amino acids such as aspartic acid, glutamic acid, histidine, leucine, lysine, proline, phenylalanine, and tyrosine. These amino acids are organic compounds that serve as the building blocks of proteins, playing a key role in growth, digestion, energy production, and overall bodily functions. Additionally, some amino acids can aid sleep, prevent muscle loss, improve mood, and support weight loss [26].

III. CONCLUSION

Coconut water, known for its refreshing taste, offers notable health benefits due to its bioactive chemical components, impacting fields like plant biology, biotechnology, and biomedicine. Cytokinins in coconut water, with their potential anti-cancer properties, are particularly promising for cancer research. Ongoing studies underscore its potential to

enhance human health. Recent discoveries highlighting the medicinal values of coconut water suggest significant potential for improving human health. Gaining a deeper understanding of the functions and properties of its individual components will enable us to more effectively utilize this remarkable and multifaceted natural liquid.India, a major player in coconut production, ranks third globally in both area and output. While traditionally underutilized, coconut water is becoming popular as an exotic beverage, particularly in regions distant from coconut farms. With convenient packaging and modern technology, coconut water competes well with soft drinks, appealing to health-conscious consumers and boosting both local and international demand

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