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Review

TIGER NUT *(CYPERUS ESCULENTUS)*: SOURCE OF NATURAL ANTICANCER DRUG? BRIEF REVIEW OF EXISTING LITERATURE.

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ABSTRACT

In some parts of the world, *Cyperus esculentus* L. is widely used as a healthy food for both humans and animals due to their nutritional and functional properties. Current research and reviews on this plant have focused mainly on organoleptic properties, phytochemical compositions, oil content, biochemical activities, and nutritional values. The medicinal properties of Tiger nut are seldom discussed, although its medicinal use is well known in folklore activities. To explore the medicinal properties of Tiger nut, this review tries to investigate the potential anticancer properties of components issued from Tiger nut by reviewing the existing literature in the field. Based on the evidence from the review, it is recommended that there is a need for further investigation into the proposed anticancer properties of Tiger nut.

1. Introduction

Tiger nut (*Cyperus esculentus* L.) also called chufa sedge, is a tuber known under various names such as: nut grass, earth or ground almond, yellow nut and edible galingale [1]. It is commonly used as a healthy food for humans and animals in some parts of the world like Africa, Europe and America [1]. Tiger nut contains high amounts of starch, minerals, oil, and vitamins C, D and E. Due to its high content of starch, its nutritional content and sole beneficial properties, *C. esculentus* L. is believed to contain all the functional compounds needed for a balanced diet [2-4]. Its many uses are as follows: beverage, milk or fermented milk product (such as yoghurt), flour, edible oil, honey, nougat ("*turron*" in Spanish), jam, beer, liqueur, chocolate, candies, a feed source and as soaps [1, 5-11]. Even though there are several examples of plants that amass high quantities of starch or sugars in tubers and roots, Tiger nuts are found to amass a substantial amount of oil in such parts. With the high oil yield and milk content, Tiger nuts are shown to have more prospective usage as food and industrial materials. Existing study and reviews are focused largely on nutritional values, organoleptic properties, phytochemical compositions, oil content and biochemical activities. The medicinal properties of Tiger nut are rarely discussed, although its usage in orthodox activities is well known. This paper explores the medicinal value of tiger nut from existing literature in the field, with respect to its potential anticancer properties.

2. Discussion

It has been reported that Tiger nuts were characterized by high levels of starch (295 g/kg), high fat contents (30 %), significant amounts of fiber (4.3 %), richness in calcium (152 ppm), phosphorous (123 ppm) and sodium (140 ppm) in proximate evaluation, with emphasis on the characterization of its oil extracted compared with olive oil [12,13]. A deficiency in calcium and magnesium has been associated to a high risk of cardiovascular diseases like hypertension. Calcium is thought to decrease the risk of preeclampsia, and may have a protective role against colon cancer [14]. In 2004, an analysis by Cancer Research UK revealed that people with the utmost levels of calcium consumption (from food / supplements) lessened their risk of bowel cancer by 22 % compared to those with the lowest calcium intake. Though another study in 2010 found that calcium supplements had no effect on colon cancer risk in the general population, it did find a connection between calcium ingestion and a reduced risk of polyps' recurrence in the colon after earlier treatment. Polyps however, are growths in the bowel that may develop into cancer

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over a long period of time, if left untreated. Therefore, calcium might indirectly affect the wellbeing of the colon. It was also suggested by Cancer Research UK that vitamin D be added to the calcium intake because it is needed to absorb calcium. This is proven by a study in 2006 where only people with high intakes of both calcium and vitamin D had a lower risk of bowel cancer. Other studies have further shown that people with the uppermost intakes of vitamin D have a lesser risk of cancer and polyps of the bowel. Currently, the World Cancer Research Fund (WCRF) categorizes vitamin D as most likely protective against bowel cancer.

Likewise, Tiger nut has been reported to be high in dietary fiber content, which could be effective in the cure and prevention of numerous diseases including colon cancer, coronary heart disease, obesity, diabetes, gastrointestinal disorders and in losing weight [15-19]. Similarly, Tiger nut is known to be a good carrier of unsaturated-fatty-acid-rich oil as reported by Sánchez-Zapata, because of its fiber contents [1]. The epidemiological studies done by Farvid on the influence of fiber on breast cancer have reinforced the hypothesis that higher fiber intakes reduce breast cancer menace. Hence, fiber consumption during youth and early adulthood might be particularly important [20]. In line with this, dietary fibre has been classified by WCRF as most likely protective against cancer of the bowel. However, the evidence is not conclusive because the assumptions are mostly based on epidemiological studies and on the fact that some types of fibre help to carry bile acids that could potentially cause cancer more quickly through the bowel.

Shaker found that the amino acid profiles of Tiger nut oil were dominated by aspartic acid followed by glutamic acid, leucine, alanine and arginine [12]. It is remarkable that the Tiger nut and olive oils are similar in fatty acid composition, in that both oils contained palmitic acid as the main saturated acid and oleic acid as the predominant unsaturated acid [21]. Most of the claims of olive oil having anticancer properties, are primarily based on its oleic acid content. The lipid profiling of the oil was further investigated by Adel, confirming Shaker and Ezeh's comparison of Tiger nut oil with olive oil. Menendez, and Sun reported that oleic acid, the key monounsaturated fatty acid of olive oil, and also that of Tiger nut oil, suppressed overexpression of Her-2/neu, hence interacted synergistically with anti-Her-2/neu immunotherapy by facilitating apoptosis of breast cancer cells with Her-2/neu oncogene amplification [12, 21-24]. Furthermore, oleic acid has been found to be a modulator of tumour chemosenstivity in paclitaxel-based therapy [24]. A review by Sales-Campos showed various health benefits of oleic acid in nutrition and metabolism, immune response, prevention of certain types of cancer, blood pressure regulation, cardiovascular diseases, cell membrane fluidity and cutaneous effect on drug(s) absorption [25]. These data could suggest that Tiger nut would carry the similar benefits as oleic acid, since it's one of the main components.

Although fatty acid content in Tiger nut oil is similar to that of olive oil, Tiger nut oil has distinctive gold-yellow color, highly unsaponifiable matter, phytosterols (only 0.2% in olive oil), especially ß-sitosterol, and a neutral taste properties [1, 21, 26]. ß-sitosterol was proven to inhibit HT-29 human colon cancer cell growth and alter membrane lipids such that a 50% reduction in membrane sphingomyelin (SM), changes in phosphatidylserine (PS), and phosphatidylinositol (PI) with cell grown in uM ß-sitosterol [27, 28].

In conclusion to his work, Awad suggested that the possible observed growth inhibition by beta-sitosterol may be mediated through the influence of signal transduction pathways that involve membrane phospholipids [28].

A study on the antioxidant activity of Tiger nut indicated that it could be utilized to 'mop up' and scavenge free-radicals, generate essential metabolic body reactions and environmental pollutants [13]. It was also suggested that addition of Tiger nut as a side dish and adjunct in traditional diets would probably alleviate the symptoms associated with neurodegenerative and cardiovascular diseases [13]. Besides, with its high content of vitamin E and Quercetin, Tiger nut might help provide cellular protection against free radicals and exert cancer cell-specific inhibition of proliferation at the G_1 phase [2, 11, 29. 30]. Likewise, its content of vitamin B could assist in balancing the central nervous system and help to encourage the body to adapt to stress [31]. Regarding its anti-stress effect, a study done by Oyedepo showed that Tiger nut had hepato-protective activity against hepatotoxicity induced by carbon tetrachloride in rats [32]. Furthermore, Tiger nut has been presented as a potential source of feed stock for the synthesis of a relatively cheaper and non-toxic fatty hydroxamic acid (FHA) which has antioxidant and free-radical scavenging activity [33]. Over the years, there has been a growing interest in the role of FHAs as potent and selective inhibitors of a range of enzymes like HDACs. Examples are Trichostatin A (TSA), Panobinostat, and Vorinostat which are hydroxamic acids and act as an HDACi (Histone deacetylase inhibitors) [34]. They are active against Class I and II HDACs in nM concentrations. TSA can also induce cell cycle arrest and cell death by increasing p21 transcription and reducing transcription of cyclin B1, PlK1 and survivins, which are responsible for cell cycle progression.

FHA has also been reported as a chemotherapeutic agent, while a number of its derivatives have been reported as pharmaceutics in treating hypertension, cardiovascular diseases, cancer, tuberculosis and fungal infections [35-38]. Moreover, Tiger nuts have been shown to exhibit anti-inflammatory properties and immuno-stimulatory effects in immuno-competent hosts (Apolipoprotein deficient mice) according to studies carried out by Salem [39].

Apart from the many advantages described above, Tiger nut activates blood circulation and helps attenuate sperm toxicity [17, 40, and 41]. It has also been found to be a fertility booster, to stimulate sexual motivation and improve sexual performance in rats [30]. Furthermore, it has been presented to be very beneficial to sickle cell disease patients and could be harnessed in the nutritional management of sickle cell disease [42].

3. Conclusion

The foregoing discussion and evidence in literature reveal that, Tiger nut contains high amounts of nutrients, vitamins, fibre, antioxidants, monounsaturated fatty acids and amino acids that make it suitable to be part of anti-cancer diets. It also contains elements proven to have anticancer properties (Quercetin, ß-sitosterol, fatty hydroxamic acid, oleic acid, vitamin D and E).

In addition to its role in preventing hepatic oxidative stress, it exhibits anti-inflammatory effects against atherosclerotic lesions (mediated by accumulation of inflammatory cells into the inflammatory lesions in blood of the ApoE $^{-/-}$ mice). The data from the latter study showed immune-stimulatory effects in immune-competent hosts; thus, increasing its likelihood to be a good candidate for anticancer drug. Underpinned by the evidence from the review, it becomes crucial to elucidate the anticancer properties exerted by Tiger nut, in order to ascertain its unsubstantiated health claims.

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