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Review Article

Nutraceutical Properties of Water Chestnut

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ABSTRACT

Trapa natans or Water chestnut is a significant plant because of its unconditional benefits it has great importance in Indian Ayurvedic medication that is being used in the issues of the stomach, genitourinary framework, liver, kidney, and spleen. It could be severe, astringent, stomachic, diuretic, febrifuge, and disinfectant. Synthetic investigation of the fresh fruits and nuts having a significant amount of water content citrus extract and new organic product which validates its significance as dietary food additionally detailed low unrefined lipid, and significant mineral present with affirming great measure of minerals as an iron and manganese potassium were contained in the natural fruit. In this paper, the ongoing reports on dietary, phytochemical, and pharmacological parts of *Trapa natans*, as a neutraceutical and nourishing food, are reviewed.

INTRODUCTION

Water chestnut has many nutraceutical properties which are discussed below in detail:

Antioxidants

Different studies showed that the peel of water chestnuts have strong antioxidant property [1]. Different grains, vegetables and fruits have different phenolic content. Phenols show strong relation with antioxidants [2]. When the food is digested the content and structure of the phenolic compounds alter that influence the biological activity [3]. Antioxidant property of chestnuts is due to phenolic components [4]. A study carried out showed that the oligosaccharides derived from Chinese water chest nut had a high antioxidant activity when a concentration of 100ug/ml was applied. The result of the study and experiment showed that the oligosaccharides derived from the Chinese water chestnut can be used as an anti-oxidant activity and can be used as a functional food [5].

Anti-Diabetic

Chestnuts have no gluten and also have very less glycemic index (GI) for crushed not cooked grind chestnut kernels that is 54. Due to low GI, it has positive effect on the diabetic patients also for the patients of celiac disease. Many countries use cereals as a source of their nutrition so the people having the celiac disease don't find the exact foods to eat and the diabetic patients can't purchase the specific diabetic products. So, for these patients, chestnut's flour is very useful because it controls the diabetes due to low GI and celiac disease because in fiber content and no gluten. Foods with low GI causes small changes in sugar level also controls the insulin. Experiment was performed chestnut was cultivated in 3 different countries it was found out that it effects two kind of people one with diabetes other with celiac disease. An experiment was performed in which there was planned diet for diabetic patients including the chestnut. In this study, fresh chestnuts were chosen, peeled and mashed. There were 6 different diabetic patients were selected all with different ages. This experiment took 12 days to analyze the effect of chestnut on blood glucose before and after the intake of chestnut flour. In first four days the glucose test was done at 7pm before any food intake then 30g of chestnut was given in first 2 days honeycomb with jam was given and in next 2 days chestnut flour products were given. Then the blood sample was taken after 2 hours. During the next 4 days, for the 2 days 30g of rye bread was provided having 0.055g resistance starch test

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was performed before and after meals chestnut products were compared with the rye bread during last 4 days they were given normal routine diet. It was found out after intake of chestnut flour products, there was sudden decrease in blood glucose and maintains the insulin levels. Reduced GI (83.33%) in diabetic patients indicates low blood glucose than before [6]. Chestnut oil protects from diabetes and lowers the cholesterol because it is composed of a number of polysterols especially β-sitosterol [7-9]. Water chest nut extracts have been experimented in treatment of hyperglycemia when tested on rats. In this study the methanol extracts derived from the water chest nut roots were used on induced diabetic rats when given doses of 50, 100 and 200 mg/kg bw .the results of this study showed anti hyperglycaemic effects [10]. Water chestnuts for a long time has been used as medicine and food but its is still unknown that what ingredients are present in it and what are their physiological functions [11]. Successive fractions of ethanol and ethanol extracts are obtained from the roots of *Trapa natans* and it has been regulated in sucrose loaded and STZ- is then moved in diabetic Wistar rats with the doses ranging from 50, 100 and 200 mg/kg bw. Hepatotoxicity risks and lipid peroxidation has not been caused due to ethanolic extracts and its fractions [30]. In another study conducted on diabetic wistar rats, water chest nut was found to have a normo-glycymic and oral glucose tolerance effect [12].

Anti-tumor Effects

Water chest nuts have been studied for their anti-tumor properties and anti-proliferative properties. In an experimental study the extracts from the water chest nut showed anti proliferative properties when tested against human colon cancer, human breast adenocarcinoma cell line, and human ductal epithelial cell line and it can be used in future treatments of cancers though further investigation and studies are required [13]. Similarly, in another experimental study the flavonoids extracted from the peel of water chest nut showed nitrite scavenging effects and cell inhibiting activitity. the experiment revealed that they inhibited A549 cell activity at G1 phase and caused cell death or necrosis which meant that it may be used as ant proliferative agent [14]. An invention was made to use the extracts from the water chest nut as prevention and inhibition of cancer activity. When the extracted material was administered to the subject through this specific invented method, resulted in inhibition of metastasis of cancer in colon, lung, liver, kidneys, breast or cervical [15]. It has also been reported that the kernals and peels of water chest nut has many phytochemicals that showed antioxidant as well as anticancer properties. Due to their specific properties and abundance of supply they can be used in food as well as non-food organisations [16]. Silver nano particles have been used for anticancer therapy. In experimental study water chest nuts were used to produce these ecofriendly silver nano particles from their leaves. Hence, this proved they could be used for cancer therapy in the future [17]. In another literature review it was shown that the extracts from the stem of the water chest nuts can be used as anticancer agent [18]. In a study which showed that Gallic acid extracted from the water chest nut had anticancer activity. This study investigated this anti-proliferative activity if Gallic acid in the HEPG2 and human hepatocellular carcinoma cell lining .The results showed that Gallic acid was able to inhibit proliferation of HepG2 and SMMC-7721 cells and can be used in the future for the anticancer therapy of hepatocellular cancer [19]. This particular study has been given in literature review "different fruits and juices that can prevent cancer or has anticancer properties" showed that the methanol extracts from the fruit of water chest nuts helped in the prevention of hepatocellular cancer [20]. In another study Gallic acid derived from the water chest nut was used as an anticancer agent who induced apoptosis in pancreatic cancer cells. The results showed that Gallic acid induced apoptosis in pancreatic cancer cells through mitochondrial mediated pathways and can be used in the future for selective induced apoptosis in cancer cells [21]. An in vitro study showed that the pericarps of the water chest contain many polyphenol, saponins and flavonoids. Amongst these extracts showed ant proliferative effect on human gastric cancer cells and human hepatic carcinoma cells. They also did not cause any toxicity to the normal cells thus the extracts can be used in anticancer therapy [22].

Anti-Obesity

In the study of Japanese horse chestnut there is a highly polymeric proanthocyanidins are present which have great anti-obesity effect. They try to check the effects firstly on animals to evaluate the benefits of Japanese horse chestnut by the use of oral starch tolerance test to assure the reduction of glucose level in the blood and to check influence of anti-obesity in mice [23]. European horse chestnut seed that include high quantity of escins (triterpenoidal saponins) they have many biological effects for examples it inhibits the high level of glucose in the blood and hinders the absorption of alcohol. Additionally, it protect capillaries and prevent from inflammation [7]. In chestnuts have saponins that are pure and are eatable plays in an important role it blocking lipase present in pancreas and also protective against obesity through assimilation and fat breakdown [24]. Most people of Asian like chestnut due to its different flavor [25]. In our country water chestnut known as singhara, its family is *Trapaceae* and specie found is *Trapabispinosa roxb*. China export water chestnut to many countries. For industrial and commercial purpose it is used because of high content of sugar. It is mostly consumed by people because it have starch which is stored in the cell wall. This has many specific functions. It is used for

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commercial purpose due to its starch content. Its highly use in industry because of its valuable data. It consumption is productive for humans [26]. Dried and cleaned water chestnuts are used for the separation of starch. Tulyathan et al proposed a method used for the isolation of starch [27].

Antibacterial Properties of Water Chestnut

The infectious and disease causing microorganism may have unsuitable impact on safety, shelf life and quality of food. This is the main reason of increasing foodborne illness [28]. Few preservative and chemical reactions made the command to minimize the occurrence of food poisoning and detoriaition of food. So the imprudent employment of this element has the development of multidrug resistance microbes and cause hypersensitivity, immune suppression and allergic reaction in host [29]. Water chestnut of Chinese (Eleocharis dulcis) is the famous food for the people of Asia due to its exclusive flavor [5]. The grassy plant is the part of sedg family that is construct in moist farmlands and located in low geographical area. It is recommended that this plant has many heath related benefits like antimicrobial effect of bacteria, antioxidant activity inhibition of inflammation and treatment for pharyngitis and laryngitis [30, 31]. Basically Chinese water chestnut are properly cleaned with water, cut into pieces and slices are made, then filled before selling out in restaurants, houses and hotels [32]. Gernelly water chestnut skin is removed during food processing and the skin weight is 20% of the total fruit.*Trapa bispinosa roxb*(water chestnut) is fruit plant and grown mostly in moist areas of world. A starchy fruit and very rare use in Bangladesh. Now a days most of the medicine are made from this fruit plant which is not dangerous and free from hazards [33]. Natural organism perform a vital role in drug development for many pharmaceutical industry [7]. Microorganisms have ability to produce resistance against many antibiotic so that's why there is unease to treat many infectious or disease causing illness [34]. The bacterial response of *Eleocharis dulcis* taken out against *Bacillus subtilis* was too much high as compared to other bacterias [35].

Cardio-Protective Effect

The powerful anti browning agent is salicylic acid and because of its potential use in fresh chinese water chestnut was look over. Quality of eating, different changes in colour and probability of having disease has been checked, and on the other hand the activities of other compounds has been measured [36]. The study was performed on the neonatal rat cardiomyocytes to investigate its effects [37].

Anti-Inflammatory Activity

A study conducted showed that the treatment with the boiling water the water chestnut has been extracted resulted in a very clear increase 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical-hunt activity and decrease the H^2O^2-loaded of reactive oxygen species in between the cells. The results of this study indicate that water chestnut may be a very good anti-inflammatory agent used tropically [38]. The main reason of the study was to assess *in vitro*, whether it may not cause inflammation, it may not cause microbial activity and may not cause oxidation activity of leaves of *Trapa natans (Linn.)* [39]. The study was conducted to investigate the results of escins that have been removed from horse chestnut, the seeds of *Aesculus hippocastanum* and *desacylescins* [40].

Anti-Microbial Activity

Different types of solvents have been used to extract *Trapa natans* fruit rind with more polarity; using different chemicals 1,4-dioxan, chloroform, water, acetone, ethanol.The suppressive effects of the product removed and collected were matched with the antimicrobes. The experiment shows the antimicrobial effect of water chestnut [41].

Gastro-Protective Activity

The source of Castena is polyphenols of its high tannin content their fruits are used in food industry for flour or sweets making. Due to of its phytochemical in chestnut having a anti-inflammatory property in gastric cells. Proanthocyanidines is a class of anti- inflammatory and promotes their pharmacological potential in the area of gastric inflammation. Thus, chestnut fruit can be included in the list of proanthocyanidin's natural resources, particularly in the skin inside and outside. It may also provide an index to titrate nutarceutcicals enriched with tannin. While our data clearly indicated that the edible portion of chestnut fruits was not involved, proanthocyanidins and consequently significant anti-inflammatory activity (IC50<1µg/ml enriched the substance by itself. These results lead to the estimation of the beneficial health benefit of foods and nutraceuticals dependent on chestnut and to the possible value of chestnut based waste [42]. Of its high tannin content in Chestnut tree which provide a dietary nutrients that shows the low levels of polyphenols [43]. Some studies have reported high phenol content and marked antioxidant properties on industrial by product in chestnuts [44,45]. Water chestnut *(Trapa bispinosa)* after extraction give starch and as stabilizing agent it is used in yogurt. It also helps in digestion of substances and molecules [46].

Inhibitory Properties

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As an inhibitory effect on α-amylase and α-glucosidase water chestnut has been used. Some experiments on water chestnut like ingestion in humans give results of decrease in postprandial blood glucose level. Water chestnut is also become a functional food item and it can have good effects in lowering glycation stress and also controlling blood glucose levels [47]. For nano-encapsulation of catechin water chestnut were prepared. The viral components that are coming from outside in the body also inhibits by water chestnut [48]. Some studies also explain inhibitory and antioxidant effects of water chestnut *(Trapa japonica Flerov.)* that were assess to give its possible use as an inhibitory factor. So, water chestnut is also useful in treating diabetes mellitus [49]. In Asia and Europe water chestnut is grows that is an annual aquatic plant. Water chestnut has also been used as herbal medicine and sometimes as food and it has some physiological functions and active inhibitory functions [50]. Chinese water chestnuts after derivation gives oligosaccharides and polysaccharides that possess good properties of inhibition and it can be used as new functional foods and dietary supplements [5].

Anti-Proliferative Properties

As compared to native water chestnut starch the peak viscosity was reduced in all modified starches. After pre-gelatinization and acid-thinning the starch paste was reduced but acetylation was increased [51]. This investigation deals in different solvents in which antiproliferative activities of water chestnut extracted and this deals with the study of antioxidants and polyphenolic [52].

Gelatinization Properties

The studies give explanation to the gelatinization of water chestnut starch and lotus root starch. The circumstances of varying concentrations of different sweets and glucose on gelatinization temperature were also measured [53].

CONCLUSION

The orderly survey of Unani, Ayurvedic writing demonstrates that *Trapa natans* have ability in the treatment of conditions, for example, the runs, dysuria, polyuria, sexual debility, general debility, sore throat, and lumbago. The ongoing pharmacological examinations uncover it has significant pain-relieving, anti-infection, antidiabetic and immunomodulatory functions. The worldwide enthusiasm toward conventional drugs is expanding because of the safe and tried and true cures with lesser reactions. This review reveals *Trapa natans* are proved to be a neutraceutical plant that has massive therapeutic and dietary benefits and advantages.

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