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Review Article

Physicochemical Properties of Water Chestnut

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ABSTRACT
Trapa natans, sometimes known as water chestnut, is a small herb that belongs to the *Trapaceae* family and is widely used across the world due to its nutraceutical characteristics. Gongorrhea, menorrhagia, and other genital infections are all treated using the whole plant. It is most commonly used to treat diarrhoea, constipation, ophthalmopathy, ulcers, and wounds. These are also used to treat serious conditions in pitta, such as consuming sensations, dipsia, dyspepsia, discharge, hemoptysis, looseness of the bowels, diarrhoea, and, strangely, irregular fever, disease, weakness, aggravation, urethrorrhea, breaks, erysipelas, lumbago, pharyngitis, bronchitis, and general debility *Trapa natans* has a great quantity of minerals, particles, to be particular, Ca, K, Na, Zn, and nutrients; saponins, phenols, alkaloids, H-gift, and flavonoids are accounted to be in the plants, maybe because to their photochemical characteristic. Dietary and biochemical studies of *Trapa natans* derivatives in 100 g revealed. Carbohydrate content was 22.30 and 71.55 percent, protein content was 4.40 percent and 10.80 percent, moisture content, fiber content, and fat content were 70.35 and 7.30, 2.05 and 6.35, 2.30 and 8.50, and 0.65 and 1.85, respectively, the mineral content of the seeds was 32 mg and 102.85 mg calcium, 1.4 and 3.8 mg iron, and 121 and 325 mg phosphorus in 100 g, and seeds of *Trapa natans.*

INTRODUCTION
Trapa natans (water chestnut), known as singhara in India, has a place in the *Trapaceae* family, is a free-skimming plant that grows in shallow water fields, lakes, or soils. Water chestnut is a neighborhood to Asia, Europe, and Africa, where the bug parasites are helf around inside the proper cutoff. This supports the addition of adequate water with a pH of 6.7 to 8.2 and a calcium carbonate alkalinity of 12 to 128 mg/l.The bits are eminent to eat and contain sugars, proteins, and head minerals. They are spoken to be utilized in different ayurvedic strategies as diuretic, love blend, supplement, goody, astringent, coolant, antidiarrheal, and tonic. They are in like way noteworthy in lumbago, sore throat, bilious enunciations of love, bronchitis, uniform, and annoying. The usual things are not all that terrible wellspring of food having 16% starch and 2% protein. The stem is utilized in eye issues as juice. The plant *Trapa natans* has comparably been assessed for different exercises, including torment mollifying, easing, against diabetic, and unpleasant to microbial. The making uncovers the utilization out of parts as a diuretic, sexual enhancer, supplement, goody, astringent, coolant, antidiarrheal and tonic, trademark things as an unbelievable wellspring of food having 16% starch and 2% protein, plant as torment calming, calming, against diabetic and threatening to microbial and stem in kind of juice in eye issue. The current assessment will give extensive data on the built constituents and, for the most part, pharmacological exercises of this plant [1].

Storage Studies of Water Chestnut Flour
The goal of the study was to determine the minimum lead content of low glycemic paper water chestnut flour (WCF) packaged in high-density polyethylene (HDPE) and low-density polyethylene (LDPE) packs for a half year under controlled conditions (temperature = 28.40 + 2°C and R.H. = 63.5 = 5 per cent10). Approximately

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10.20 per cent, 0.23 per cent, 2.79 per cent, 3.09 per cent, 2.36 per cent, and 81.30 percent of W10F accumulated in HDPE sacks and 10.35 percent, 0.20 percent, 2.*7*4 percent, 3.07 percent, 2.37 percent, and 81.22 percent of WCF accumulated in LDPE packs were recorded at the completion of the limit, moisture, fat, protein, fiber, flotsam and jetsam, and starch substance. Water activity, mass thickness, total titrable sharpness, hard and fast phenols, FFA, and full scale plate were calculated as 0.43, 0.52 g/cm3, 0.21 percent, 4.26 percent, 0.45 percent, and 1.9 x 102 CFU / g for WCF assembled in HDPE bags and 0.44, 0.50 g/cm3, 0.23 percent, 4.16 percent, 0.86 percent, and 2.6 x 102 CFU / g HDPE was preferred over LDPE for preserving the flour consistency [2].

Effect of Moisture Content on the Heat-Sealing Property of Starch Films from Different Botanical Sources

In this study, the clamping substances were assessed for their effects on crystallinity of starch films (mung bean, water chestnut, sweet potatoes, water chestnut, and cassava starches) under varied humidity circumstances. (11 per cent, 22 per cent, 33 per cent, 43 per cent, 54 per cent, 75 per cent and 84 per cent) and their fixing properties and warns bonding. The X-shaft diffraction analysis revealed a link between the degree of crystallinity and the starch film's clamminess content: the lower the crystallinity, the higher the clamminess content. Field Emission Scanning Electron Microscopy (FE-SEM) analysis demonstrates that films with low moisture content could not be followed thoroughly. However, movies with a high soddenness material and low crystallinity demonstrated outstanding adherence, with two motion pictures correctly observed as comparable temperature, since water molecules went about as a convey ability enhancer. The 5 ripping test demonstrated the loss strategies for the Glow bound motion images. The cassava starch film, which had a lower amylose content and crystallinity, demonstrated better protection diverged than other starch films [3].

Impact of Water Chestnut Extract on the Shelf-Life of Referigerated Catfish Fillet

The purpose of investigation was to find the impact of the removal of H2O from this nut tree on the Siluriform fish filet removed at low inversions.Varius phases have been completed, including testing, test preparation, test uprooting, and filleting of fish.Uprooting of soaked staggered with a mixture of solvents C6H14,C4H8O2, and *7*0 % liquor and was done. The factors monitored were gratified amino acids. TVBN, TPC, and whiteness. The results indicated that gratified protein falls while TVBN and TPC amounts rose while stored. The expansion of this nut concentrate lowered the degrees of TVBN, TPC and whiteness of the filet [4].

Structural Characterization, Neuroprotective and Hepatoprotective Activities of Flavonoids from the Bulbs of *Heleocharis dulcis*

Hazel on broadly taken as a natural food or herb commodity in China since antiquated occasions. This reveals elevating well-being properties that give rise to a 2road analysis of their dynamic parts. Progressive chromatography of dynamic parts H. Dulcis resulted in the seclusion of five new heterodimers (1-3, 6, 9), four new flavonoids (4,5 , 7, *8*2 and sixteen known flavonoids subordinates (10-25) on the basis of their I.R., U.V., NMR, MS spectrometry information examination and references from H. Dulcis just because of that. For these segregates, 4, 7, *9*, 12, 13 and 17 indicated moderate neuroprotective activity, raising the cell endurance levels from 49.23 + 3.68 per cent for the sample to *67.75* + 275 per cent, 57.83 + 2.46 per cent, 67.98 = 2.74 per cent, 58.65 + 3.43 per cent, 56.14 + 1.99 per cent, and 56.70 + 1.38 per cent, respectively, at 10 UM. In addition, mixtures 1–3, 15, 16, 18 and 20 were found to significantly refine the HepG2 cell endurance rate from 39.53 per cent (APAP, 10 mM) to 45.53–53.44 per cent. The result of the examination has given vital data concerning the basic decent variety and the medical advantages of H consumable bulbs of Dulcis.e filet, and the whiteness [5].

Ectomycorrhiza is Used to Assess the Development of Chestnut Seedlings and the Drought Response

Even though agriculture around linear batch in the Middle west, U.S.,hazel (Castanea) will have many purposes in decayable locations. Because (ECM) habitation is also essential for the base and development of trees, we have tended to the 14 portance of ECM habitation for the execution of chestnuts by survey: (1) regular ECM habitation in built-up nut plantations, and (2) t4e effect of ECM immunization on seedlings and dry season reactions in nurseries. We selected 50 Chinese American half-breed chestnut trees in a trading estate and surveyed their degree of mycorrhazia habitation comparable to that of the nearby timberland, the wellspring of inoculum. We grew 80

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seedlings from this plantation in the greenhouse, with and without mycorrhizal immunization. Half of the findings of the immunization and biomass surveys were collected; the rest of the exposures to exploratory water pressure were analyzed using Fv / Fm chlorophyll fluorescence. In plantations planted with uninoculated spe 4es, ECM habitation diminished by good means from the adjacent oak backwoods (P = 0.015), the putative ECM source, with a typical 29 percent root tip colonized. ECM immunization raised seedling over-the-ground biomass by 16.4 per cent in the nursery and raise 1.14 more stomata on leaves, however small it may be. Water risk in EM-vaccinated seedlings have improved better from an exploratory dry spell with tall Fv / Fm confidence (P = 0.004) than uninoculated seedlings. Our investigation reveals that (ECM) habitation can figure out chestnut trees in their initial development and resistance to stress and should be incorporated into field planting in order to limit their reliance on farming revisions [6].

Structural and Visco-thermal Characterization of Water Chestnut Flour

Water chestnuts were exposed to pre-improved pre-forming conditions in order to establish flour recovery, healthy starch content, and to reduce glycemic record and glycemic load. From that point on, low glycemic record water chestnut flour (F1) was explored for different pragmatic, gooey, warm and adjunct properties. F1 has shown improved valuable characteristics as a result of the starch gelatinization followed by retrogradation during pre-shaping, which affirms its attainability for the advancement of food-grouped things interestingly with monetarily open market flour (F2). Staying properties top thickness, retaining strength, breakdown thickness, last thickness and set back depth (SBV) were observed to be higher out and out ($p < 0.01$) if F1 was to occur than F2. The higher apex thickness of F1 can be accepted to a higher extension limit than that of F2. Therefore, the low SBV of F1 suggests its impotence against retrogradation and gel improvement. Differential calorimeter inspection tests showed that gelatinization temperature, endothermic apex distance, start, zenith and end temperatures were typically lower ($p < 0.01$). On the other side, the enthalpy of the gelatinization and apex height records is significantly greater inside than outside ($p < 0.01$) because F1 had to be the case when it varied from F2. Lower gelatinization progress temperatures of F1 could be credited to a much more water ingestion limit than F2, which suggests its potential as a thickening administrator in sustenance's. ATR-FTIR inspects showed a high degree of absorption at 1047/1022 cm-1 in F1 as it stood out from F2, which demonstrated the similarity of double helices in the crystalline starch districts in the F1 examination. Checking electron microscopy revealed smooth, plumper, and interlaced granules in F1, while crumpled granules were seen in F2 [7]. Beneficial effect is equal to wheat [8].

Chemical Characterization, Antioxidant Properties and Anti-Inflammatory Activity of Chinese Water Chestnut Extracts

Ferulic acid, caffeic acid, and p-coumaric acid have been recognized in the Eleocharis dulcis. (Chinese water chestnut (CWC) ethyl acetic acid derivation extricate. The most elevated calming movement was presented by 300 *u*g/ml CWC ethyl acetic acid derivation extricate, which additionally fundamentally diminished nitric oxide creation ($p < 0.05$). Treatment with the CWC ethyl acetic acid derivation separate downregulated the declaration of TNF-a, iNOS, and COX-2 qualities. Just because the distinguishing proof of phenolic acids from CWC and their relationship with the calming movement were accounted for in this work [9].

Influence of Processing Time on Physicochemical Properties and Vitro Digestibility of Food in Packaged Chestnut Kernel

An extended period of usagility is significant for the modernly bundled cooked part of the chestnut. The goal of this research is to examine the physicochemical and stomach related characteristics of starch in prepared chestnut for fluctuating periods of as long as one year. Amylose falls down clearly in the course of the underlying depository for two months and grows step by step over the next ten months. During stockpiling, the amount of gelling reduces, while the degree of retreating (D.R.) increments. The total impurity of chestnut water which is prepared improves during capability and indicates a strong +ve relation to DR. Fastly edible starch (RDS) 8tclines

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dramatically within the timeframe of practical usefulness. Starch retrograding and respective impurity indicate a crucial -ve relationship to RDS material. the short-range atomic order for starch corresponded to the amount of increasingly absorbable starch. Results show that the edibility of the cooked piece of chestnut decreases during capacity due to the increase in crystallinity of the starch [10].

Structure and Digestion Rate

Utilizing joined methods and two correlations (corn and manioc), that efforts examine construction or immersion step of aquatic plant stem corn. among the corn flours, the aquatic plant corn indicated adjusted various leveled auxiliary highlights and a generally low assimilation rate. the basic system on the diminished assimilation pace of aquatic plant corn was talked on basis of a progressive auxiliary sight. in particular, contrasted and corn flour, the h2o aquatic plant flour had no holes on the grain top, with the deep crystals of flake, the expanded flake requesting, or raised substance of crystals. these auxiliary highlights presumably expanded the mass thickness of atom gathering in starch and in this way could ruin the dispersion of protein particles in starch grids. therefore, the ingestion of chemical to corn series can impeded, bringing about diminished compound division pace of corn series. the generally enormous polysaccharides particles of aquatic plant corn likewise would in general decrease the starch assimilation rate, related with the improved atom associations, for example, in beans series. likewise, the more decrease in processing pace of manioc could be additionally attributed to the varieties in the many auxiliary highlights [11].

Drying and Rehydration Characteristics

drying and rehydration characteristics: drying attributes of aquatic plant were assessed in an industrially accessible bureau broiler at various heat to contrast the wizen toll or with break down the impact of various wizen heat of air on moisture effects. the item dried at 70 °c would be advised to rehydration attributes. the highlights of fantastic carbon dioxide adsorption affects, minimal effort crude substance, little response heat or easy planning exhibit that these adsorbents are imminent for use of carbon dioxide catch [12,13].

Effect of Particle Size

Effect of particle size: impact of molecule size on compositional, practical, sticking, warm and natural philosophy of business aquatic plant dough had examined. the liquid belonging extent , grease belonging extent, or silt capacity division diminished along diminishing molecule bulk or dregs capacity portion of all examples expanded quickly at less than 100*c influencing elastic capacity of aquatic plant. daintiness esteem expanded for greatest at the time molecule bulk was decreased. this exhaustively led examination for useful, gluing and liquid characteristics of business aquatic plant dough as affected by molecule size will useful for improving sans graham item advancement for people who have abdominal problems [14]. this plant tree has property to prevent several health disorders [15].

Functional Properties

this examination was conducted to decide the impact of different glues on useful and gluing characteristics of corn detached from aquatic plant . structural characteristics of aquatic plant corn with glue were concentrated by examining it. the expansion of glue altogether diminished the sticking heat of aquatic plant showing simplicity of difference. the mishap was quickened within the sight of thickener yet postponed the impact during the refrigerating of the corn glue. just thickener was seen as powerful in expanding breakdown demonstrating great glue security of wcs [16].

Social and Environmental Implications

Water chestnut might be advanced for mass development utilizing the suggested culture convention that would help catching environmental carbon, give healthful security and business age and asset use [17].

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Structural and physiochemical properties

Aquatic plant is full of corn generally devoured all through the oriental nations. in this examination, diverse synthetically changed carboxy methylated starch showed the most elevated growing force, dissolvability, glue lucidity and safe corn material, inferring carboxymethylated corn may have use in food processing industry [18].

Effect of nacl on physiochemical properties

Expansion of nacl diminished the expanding intensity of wcs alone, while it expanded if there should be an occurrence of wcs – xg blend. the water retention of wcs – xg improved radically by the expansion of nacl while a quick decrease in syneresis was seen with wcs – xg blend. the straightforwardness of both wcs and wcs – xg blend were seen as expanded after the expansion of nacl [19]. Recognizing the two united states water chestnut will be significant for recording extend and distinguishing current populaces, for additional investigation for planning and adequacy of physical, concoction, and organic control choices. this examination additionally features requirement for a complete geological overview of water chestnut structure and hereditary qualities to explain the scientific categorization [20].

REFERENCES

1. Shalabh B, Akash J, Jasmine C. Trapa natans (Water Chestnut): an overview. 2012.
2. Beigh MA, Hussain SZ, Naseer B, Rouf A, Ahmad Raja T. Storage studies of water chestnut flour. Journal of Food Processing and Preservation. 2020,44(2):e14321. doi.org/10.1111/jfpp.14321.
3. Suh JH, Ock SY, Park GD, Lee MH, Park HJ. Effect of moisture content on the heat-sealing property of starch films from different botanical sources. Polymer Testing. 2020:106612. doi.org/10.1016/j.polymertesting.2020.106612.
4. Baehaki A, editor Effects of water chestnut (Eleocharis dulcis) extract on the shelf-life of refrigerated catfish (Pangasius sp.) fillet. IOP Conference Series: Earth and Environmental Science; 2020. doi:10.1088/1755-1315/404/1/012037.
5. Ma Q, Wei R, Sang Z, Dong J. Structural characterization, neuroprotective and hepatoprotective activities of flavonoids from the bulbs of Heleocharis dulcis. Bioorganic Chemistry. 2020,96:103630. doi.org/10.1016/j.bioorg.2020.103630.
6. Aryal P, Meiners SJ, Carlsward BS. Ectomycorrhizae determine chestnut seedling growth and drought response. Agroforestry Systems. 2020,1-10. doi.org/10.1007/s10457-020-00488-4.
7. Hussain SZ, Beigh MA, Naseer B, Naik HR. Visco-thermal and structural characterization of water chestnut flour. Journal of Food Science and Technology. 2020,1-11.doi.org/10.1007/s13197-020-04327-3
8. Bharadwaj K, Chandra V. Water chestnut (Trapa): A supplement to cereals and a conserver of riverine waste lands. Biological memoirs. 1980.
9. Yanga J, Tanga X, Shuaia L, Kwonb YS, Kimc MJ. Chemical characterization, antioxidant properties and anti-inflammatory activity of Chinese water chestnut extracts. SCIENCEASIA. 2020,46(2):151-6.doi.org/10.2306/scienceasia1513-1874.2020.026
10. Ding T, Kan L, Wu Y, Bai Y, Ouyang J. Influence of Storage Period on the Physicochemical Properties and In Vitro Digestibility of Starch in Packaged Cooked Chestnut Kernel. Starch-Stärke. 2020,72(1-2):1900080. doi.org/10.1002/star.201900080.
11. Qiao D, Tu W, Zhang B, Wang R, Li N,et al. Understanding the multi-scale structure and digestion rate of water chestnut starch. Food hydrocolloids. 2019,91:311-8. doi.org/10.1016/j.foodhyd.2019.01.036
12. Singh GD, Sharma R, Bawa A, Saxena D. Drying and rehydration characteristics of water chestnut (Trapa natans) as a function of drying air temperature. Journal of Food Engineering. 2008,87(2):213-21. doi.org/10.1016/j.jfoodeng.2007.11.027.

DOI: https://doi.org/10.54393/pjhs.v2i01.36

13. Rao L, Liu S, Wang L, Ma C, Wu J, et al. N-doped porous carbons from low-temperature and single-step sodium amide activation of carbonized water chestnut shell with excellent CO2 capture performance. Chemical Engineering Journal. 2019,359:428-35. doi.org/10.1016/j.cej.2018.11.065.
14. Ahmed J, Al-Attar H, Arfat YA. Effect of particle size on compositional, functional, pasting and rheological properties of commercial water chestnut flour. Food Hydrocolloids. 2016,52:888-95.doi.org/10.1016/j.foodhyd.2015.08.028.
15. Vhotracharcho C. Chironjib Banaushadhi, vol. 2. Ananda Publisheres Ptv. Ltd.: Calcutta; 1987.doi.org/10.1016/S0367-326X(00)00226-4.
16. Lutfi Z, Nawab A, Alam F, Hasnain A, Haider SZ. Influence of xanthan, guar, CMC and gum acacia on functional properties of water chestnut (Trapa bispinosa) starch. International journal of biological macromolecules. 2017,103:220-5. doi.org/10.1016/j.ijbiomac.2017.05.046.
17. Nandy S, Jana B, Lahiri S, Ghosh P, Bhakta J, et al. CNP Ratio and Dose Regulated Production of Water Chestnut Trapa: Social and Environmental Implications. Russian agricultural sciences. 2018,44(4):318-25. doi.org/10.3103/S1068367418040134
18. Xiao L, Chen J, Wang X, Bai R, Chen D, *et al*.Structural and physicochemical properties of chemically modified Chinese water chestnut [Eleocharis dulcis (Burm. f.) Trin. ex Hensch] starches. International journal of biological macromolecules. 2018,120:547-56.doi.org/10.1016/j.ijbiomac.2018.08.161.
19. Lutfi Z, Alam F, Nawab A, Haq A, Hasnain A. Effect of NaCl on physicochemical properties of xanthan gum–Water chestnut starch complexes. International journal of biological macromolecules. 2019,131:557-63. doi.org/10.1016/j.ijbiomac.2019.03.052.
20. Chorak GM, Dodd LL, Rybicki N, Ingram K, Buyukyoruk M,et al. Cryptic introduction of water chestnut (Trapa) in the northeastern United States. Aquatic botany. 2019,155:32-7.doi.org/10.1016/j.aquabot.2019.02.006.