

Health Benefits of Makhana (Foxnut) In Ayurveda and Modern Nutrition

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ABSTRACT: Recent decades across the world and all age groups have shown a marked increase in consumption of ultra-processed, processed, ready-to-eat convenience fried snacks, chips and refined foods like desserts, bakery and confectionery. These foods lack nutrient density and are rich in calories, so we can use Foxnut (*Euryale ferox*. Family - Nymphaeaceae) as nutritious food in place of non-nutrient food. It is low in fat and high in potassium, popularly known as Makhana 'Black Diamonds'.

Background: Foxnuts are becoming more important in the contemporary global context. It's rich in various nutrients, like different types of protein, carbohydrates, minerals (e.g. calcium, iron, magnesium and potassium) and dietary fiber, low in glycemic index and gluten-free.

Aim & Objective: The purpose of this review was to study the nutritional properties with functional components, health benefits and importance of foxnut as per Ayurveda and Contemporary Science.

Material Methods: Detailed Information on the topic has been reviewed and collected by screening of different classical texts of Ayurveda and relevant existing research on foxnut was assessed from various database e-engines like PubMed Central, Namaste Port al, Government sites, Scopus, Web of Science, Google Scholar, Wikipedia, AYUSH Portal and DHARA with a focus on the action foxnut in different diseases.

Conclusion: Foxnuts are a very nutritious seed that has many health benefits and contributes to the nation's food and nutritional security. They are known as "Super Food" because they contain a variety of nutrients that are necessary for regular bodily activities. It has a low glycemic index, is gluten-free and has a lot of fibre.

Keywords: Antioxidant, Black Diamond, Foxnut, Makhana, Superfood

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INTRODUCTION:

Foxnut, also known as Gorgon nut, is a superfood on a global scale due to its abundance of minerals and medicinal properties. Makhana or Euryale seeds are quickly becoming superfoods on a global scale^[1,2]. It is an aquatic crop, grown mostly in India, China, Japan, South Korea, Bangladesh, Russia and a few other countries of the world. The main Bihar districts that produce Makhana are Darbhanga, Sitamarhi, Madhubani, Saharsa, Supaul, Araria, Kishanganj, Purnia and Katihar. The districts of Darbhanga, Madhubani, Purnia and Katihar alone produce about 80% of all processed makhana. It is grown over 13,000 hectares of land. Makhana farming provides a living for thousands of resource-poor farmers, particularly in Bihar and Manipur. Grown in stagnant perennial water bodies like ponds, land depressions, oxbow lakes, swamps and ditches, this cash crop (dry fruits) is sold as Popped Makhana, also called Makhana Lawa. Makhana seeds are also known as Black Diamond seeds^[3]. In Ayurvedic treatment, Makhana flour is used often to nourish the kidney and spleen. Numerous amino acids (such as arginine, glutamine and histidine), minerals (such as trace levels of chromium and selenium) and flavonoids (such as quercetin and kaempferol) are found in foxnut and help to stimulate hormonal immunity. Additionally, foxnut is high

in folate, which aids in foetal development during the first trimester of pregnancy and has been shown to benefit postpartum women^[4].

FOXNUT IN AYURVEDA:

Foxnut is categorized in Aamraphaladi varga, is also known as Paniyaphalam (fruit born of water) and Padmavijabha (Lotus seed)^[5]. Many traditional diets are made up of foxnut, mentioned in Bhavprakash Nighantu and other classical text books. According to Bhavprakash Nighantu, they are boiled in milk and given to postpartum mothers (prasavant dauryabalya) and for spermatorrhea (shukrashrava) and ejaculation (sudden discharging of a fluid from a duct). Also, they are aphrodisiac (vajikarak), retentive (grahi), and strengthen the physique (balya). It can be eaten as a snack and is easily digested^[5]. In both Ayurvedic and Chinese medical traditions, it has been utilized for managing renal disorders, chronic diarrhoea, excessive leucorrhoea and impaired liver function. Its bioactive constituents exhibit antioxidant, antimicrobial, anti-ischemic, antidiabetic, immunomodulatory, anti-melanogenic and anti-cytotoxic activities^[6]. The Ayurvedic properties of this crop are mentioned in Table 1.

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Table 1: Therapeutic Properties of Foxnut According to Ayurveda:^[7]

Rasa	Madhura (Sweet), Kashaya (Astringent) & Tikta (Bitter)
Guna	Guru (Heavy), Ruksha (Dry)
Virya	Sita (Cold)
Vipaka	Madhura (Sweet)
Doshakarma	Katu (Bitter), Pitta shamak, Vata-Kaphavardhak
Dhatukarma	Balya (Promote strength), Vrishya (Enhances sexual potency), Grahi (retentive), Vishtambhi (constipating), Garbhsthapana (sustaining pregnancy), Dah- Raktpittashamak (diminish burning sensation & bleeding disorder)

Table 2. Different Names of Foxnut:^[8]

Sanskrit Name	Padyabeejam
Bengali Name	Makhana
Gujarati Name	Makhana
Hindi Name	Taalmakhana
Oriya Name	Kuntapadamu
Panjabi Name	Jewar
Telugu Name	Melluni Padmamu

FOXNUT IN CONTEMPORARY SCIENCE:

It is also named as “Food of God,” which is used during religious offerings. In India, the parents of the new bride send it to the groom as a marital ritual^[9]. This ingredient has been used in cosmetics to promote anti-ageing. These seeds are a popular snack due to their low carbohydrate, fat and sugar content. This benefit means that eating them in between meals will not cause weight gain^[10].

Nutritional and Health Properties of Foxnut –

Foxnut is beneficial for constipation and is thought to be an effective food for regulating blood pressure, blood sugar, heart disease and anaemia because it contains a fair quantity of dietary fibre. According to Mittal et al.,

(2020), the traditionally foxnut is used to treat liver dysfunction, enuresis, diabetic nephropathy and chronic diarrhoea^[11]. It has other medicinal values for the problems related to respiratory, circulatory, digestive, renal and reproductive systems (helps to increase the fertility of men and women^[12, 13]). Because it contains a variety of amino acids (including arginine, glutamine and histidine), minerals (like trace amounts of chromium and selenium) and flavonoids (like quercetin and kaempferol). The raw powder or popped foxnut also aids in stimulating hormonal immunity. It is a high-folate, gluten-free food that aids in the baby’s development throughout the first trimester of pregnancy and has been shown to be beneficial for postpartum mothers^[14, 12].

Table 3: Nutritional Composition of Foxnut In Relation to that of RDA:^[15]

NUTRIENT	MAKHANA (100G)	MALES (RDA2020)	Female (RDA2020)
Moisture	12.8g	-	-
Protein	9.7g	54.0g/d	46.0g/d
Fat	0.1g	30g/d	25g/d
Carbohydrates	76.9g	130g/d	125g/d
Energy	347Kcal	2710	2130
Mineral	0.5g	-	-
Crude Fiber	-	40g/d	30g/d
Calcium	20mg	1000mg	1000mg/d
Phosphorus	90mg	600mg/d	700mg/d
Iron	1.4mg	19mg/d	29mg/d

Health Benefits Along with Mode of Action of Different Bioactive Compounds of Foxnut:

● **ANTI-AGING ACTIVITY:** Foxnut contains higher concentrations of anti-ageing amino acids such as glutamine, cystine, methionine and arginine. Both raw and popped foxnuts include significant amounts of additional amino acids necessary for proper bodily functions. The precursors of creatine, Arginine and methionine –

the amino acids are good for healthy skin, hair and nails. According to Jana & Idris, 2018 amino acids have antioxidant properties that assist in preventing ageing by eliminating intermediary free radicals and ending chain processes^[12].

● **ANTI-FATIGUE ACTIVITY:** Fatigue is divided into two types: mental and physical

exhaustion, which are caused by various physiological and biochemical reasons. The rise in free radicals is one of the primary causes of physical fatigue. During physical fatigue, the antioxidant defense system weakens and is incapable of entirely preventing oxidative damage caused by excessive free radicals. A study says that the foxnut seed coat may be a viable and accessible source of natural antioxidants and could develop into a novel functional food or medication for fatigue resistance [16].

- **ANTI-OXIDANT ACTIVITY:** Antioxidants are components that help to reduce Reactive Oxygen Species (ROS) and induce oxidative stress. Antioxidants play an important function in decreasing symptoms of diseases and fighting against diseases. Due to its remarkable properties in lowering blood pressure, excessive glucose levels and disease progression, foxnut is referred to as antioxidants [17].

- **ANTI-DIABETIC ACTIVITY:** The seeds of foxnut are a good source of natural antioxidants and can help avoid diabetic nephropathy. It has been postulated that 2 β - hydroxybetulinic acid 3 β -caprylate (HBAC), an anti-diabetic active principle found in foxnuts, might be responsible for the probable release of insulin from the pancreatic β -cells, enhancing glycemic control in diabetes [18]. A

plethora of secondary complications occur in terms of reproductive health as well due to diabetes; thus, foxnut has indirect reproductive benefits as well [19].

- **ANTI-MELANOGENIC ACTIVITY:** The primary pigment in mammalian's skin is melanin which shields the skin from oxidative stress, UV radiation and DNA damage. Melanosomes produce melanin, which is then transported from melanocytes to the nearby epidermal keratinocytes [20]. In addition to promoting melanogenesis and melanocyte proliferation in the skin, UV light plays an important role in it and also causes the production of Reactive Oxygen Species (ROS) [21]. Ethyl acetate extract of Foxnut seed is evaluated for antimelanogenic activity. Antioxidants and Reactive Oxygen Species purifiers can therefore have skin-whitening effects. According to a recent study, aminoglycosides, which are redox-inactive substances, significantly altered the activities of cellular antioxidant enzymes and decreased melanin levels in human melanocytes [22].

AHARA KALPANA OF MAKHANA:

- **Makhana Drink:** It is a kind of healthy and nutritious drink prepared by using Makhana powder along with cow milk and fine powder of dry fruits and paste of some fresh dates and raisins/kismis.



Figure 1: Makhana Drink

- **Makhana Barfi:** Makhana barfi is a kind of healthy and nutritious preparation by using Makhana powder along with dry fruits, coconut powder, ghee, jaggery and cow milk.



Figure 2: Makhana Barfi

- **Health Benefits of Makhana Drink and Makhana Barfi:** Makhana is rich in calcium, magnesium and phosphorus. Dry fruit like almonds and walnuts support memory and focus. It improves digestion, rich in antioxidant and anti-aging properties.



Diagram 1: Health Benefits of Makhana Drink and Makhana Barfi

TABLE 4. AYURVEDIC PROPERTIES OF MAKHANA DRINK AND MAKHANA BARFI^[7]:

Ingredients	Synonyms	Rasa	Guna	Virya	Vipaka	Doshakarma	DhatuKarma
Makhana/ Foxnut ^[23]	Makhana	Madhura (sweet), Kashaya (Astringent), Tikta (Bitter)	Guru (Heavy), Ruksha (Dry)	Sheeta (Cold)	-	Pittashamak, Vata-Kaphavardhak	Balya (Promote strength), Vrishya (Enhances sexual potency), Grahi (Retentive), Vishtambhi (Constipating), Garbhsthan (Sustaining pregnancy), Dah-Raktapittashamaka (Diminish burning sensation & bleeding disorder)
Godhugdha, Cow Milk ^[24]	Cow Milk	Madhura (sweet)	Guru (Heavy), Mandam, Snigdha (Unctuous), Shlakshna (Smooth), Mridu (Soft), Sara (Mobile), Picchila (Slimy), Prashanna (Tranquil)	Sheeta (Cold)	Madhura (Sweet)	Vata-Pittashamak	Jivaniya (Enlivening), Balya (Promote strength), Shukrajanna (Semen producing), Aayushya (Conducive to life), Vanrya (Complexion promoting), Stanya (Enhance breast milk), Rasayana (Rejuvenation), Kinchit (A little), Kledkar (To make wet), Alpabhishtnyadi (Mild channel obstructing substance), Raktapitta (Bleeding disorder)- Bhrama (Vertigo)-Shram (Exertion)-Visha Shamak (Toxins pacify)
Vatda, Almond ^[25]	Vatda/Vatam,	Madhura (Sweet)	Guru (Heavy), Snigdha (Unctuous), Sara (Essence)	Ushna (Hot)	-	Vatapittasamak, Kaphabardhak	Balya (Promote strength), Vrishya (Spermatogenic), Raktapittakara (Bleeding Disorder)

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Akshot, Walnut^[26]	Walnut, Akhrot	Madhur (Sweet), Kinchit (Mild), Amla (Sour)	Guru (heavy), Snigdha (Unctuous)	Ushna (Hot)	-	Vatashamak, Pitta-Kaphabardhak	Balya (Promote strength), Vrishya (Spermatogenic), Rochak (Taste enhancer), Malbadhkara (Constipation), Raktapittkara (Bleeding disorder), Kshaya (Depletion of dhatus)-Hridrog (Heart disease)-Raktadosha (Blood impurity)-Raktavata-Daahnashak (Alleviate burning sensation)
Kajutak, Cashew nut^[27]	Cashew nut, Kaju	Madhur (Sweet), Kashaya (Astringent)	Laghu (Light)	Ushna (Hot)	-	Vata-Kaphashamak	Dhatuwardhak (Tissue nourishing), Gulma (Abdominal Tumor), Jwara (Fever), Krimi (Worm), Vrana (Wound), Mandagni (Low digestive fire), Kushta (Leprosy), Shwitra (Leucoderma), Grahani (Irritable Bowel Syndrome), Arsha (Hemorrhoids), Aadhamannashak (Reduce abdominal distention/bloating)
Kharjuri, Date^[28]	Dates, Pindkharjuri, Khajur	Madhur (Sweet)	Guru (Heavy), Snigdha (Unctuous)	Sheet (Cold)	Madhura (Sweet)	Tridoshshamak	Balya (Promote strength), Tarpan (Nourishing), Pushtikara (Nutritive), Shukravaradhaka (Spermatogenesis), Triptikara (Satisfactory), Rochaka (Appetizer), Vishtabhi (Constipation), Hridya (Good for heart), Kshat (Injury)-Kshaya (Demission of body)-Raktapitta (Bleeding disorder)-Kustha

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							(Leprosy)- Vatajwara (Fever due to aggravation of vata)- Jwaratisara (Fever with diarrhoea)- Abhighat (Trauma)- Chhardi (Vomiting)- Kshudha (Hunger)- Trishna (Excessive thirst)-Kasa (Cough)-Swasa (Dyspnoea)- Mada (Intoxication)- Mucharcha (Faint)- Madatyanashak (Alcoholism)
Laghud raksha, Raisin^[27]	Raisin, Kismis	Madhur (Sweet), Amla (Aklaline)	-	Sheet (Cold)	-	Vatapittashamka	Vrishya (Spermatogenic), Rochaka (Appetizer), Hridya (Good for heart), Swasa (Dyspnoea) - Kasa (Cough) - Jwar (Fever) - Raktapitta (Hemorrhagic disorder) - Kshata (Injury) - Kshaya (Depletion of body) - Swarbheda (Hoarseness of voice) - Trishna (Excessive thirst) - Mukhatiktata Nashaka (Destroys the bitterness of mouth)
Narikel, Coconut^[27]	Nariyal Coconut	Madhur (Sweet)	Guru (Heavy), Snigdha (Unctuous)	-	-	-	Balya (Promote strength), Vrishya (Enhances sexual potency), Rochan (Stimulates appetite), Durjara (Hard to digest), Malstambhakar (Constipation), Dahkarak (Burning sensation)

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Ghrit, Clarified butter ^[29]	Dughajata, Ghee, Clarified butter	-	-	Sheeta (Cold)	-	Vata-Pitta Shamak	Grahi (Digestive), Chakshusha (Good for eyesight), Daah (Burning sensation)- Raktavikara (Blood disorder) - Mada (Intoxication) - Murccha (Faint) - Bhrama (Dizziness)- Netraroga Nashaka (Destroys eye disorders)
Gud, Jaggery ^[30]	Gud, Jaggery	Madhura (Sweet), Skshara (Alkaline)	Guru (Heavy), Snigdha (Unctuous)	Natisheeta (Not Very Cold)	-	Vata-Pitta Shamak, Kinchitpittasamak, Kaphavardhaka	Balya (Promote strength), Vrishya (Increasing spermatogenic), Mutra-Rakta Shodhaka (Urinary blood purifier), Rakta (Blood)-Mamsa (Tissue)-Meda (Adipose tissue) Vardhak

- **Makhana Salad:** Makhana Salad is a kind of healthy, tasty and nutritious preparation by using Roasted Makhana along with vegetables like Tomato, Onion, Cucumber, Fresh Coriander, Lemon Juice, Roasted Cumin Powder and Rock Salt.



Figure 3: Makhana Salad

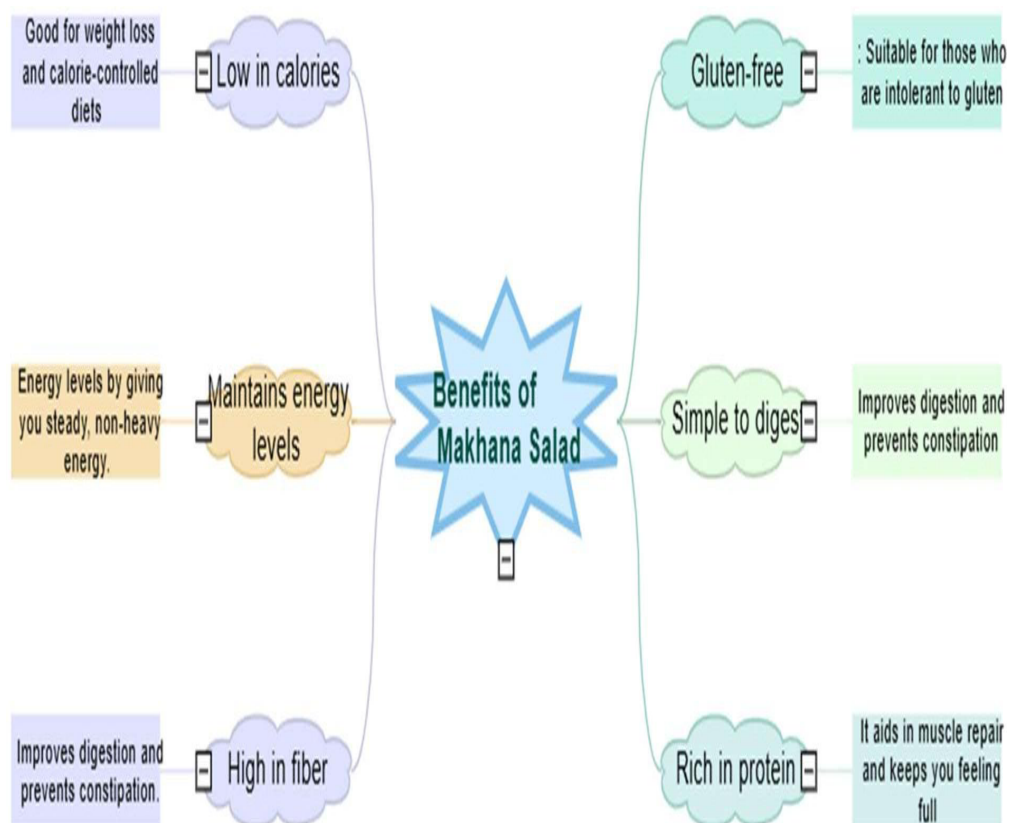


Diagram 2: Health Benefits of Makhana Salad

Table 5. Ayurvedic Properties of Makhana Salad [7]:

Ingredients	Synonyms	Rasa	Guna	Virya	Vipaka	Dosha karma	DhatuKarma
Makhann ^[23]	Makhana, Foxnut	Madhura (Sweet), Kashaya (Astringent), Tikta (Bitter)	Guru (Heavy), Ruksha (Dry)	Sheeta (Cold)	-	Pittashamaka, VataKaphavaradhaka	Balya (Promote strength), Vrishya (Enhances sexual potency), Grahi (retentive), Vishtambhi (constipating), Garbhsthapan (sustaining pregnancy), Dah-Raktapittashamaka (Diminish bleeding disorder)
Palandu, Onion ^[31]	Onion, Pyaj	Madhura (Sweet), Katu (Pungent)	Guru (Heavy), Tikshna (Sharp), Snigdha (Unctuous)	Sheeta (Cold)	Madhura (Sweet)	Vatashamaka, Kinchitpittakaphavaradhaka	Balya (Promote strength), Deepan (Appetizer), Brinhan (Nourishes dhatus), Mutrajanna (Diuretic), Shukradaurbalya (Oligospermia), Nidra Karaka (Induce sleep)
Gargar, Carrot ^[32]	Gajar, Carrot	Madhura (Sweet), Tikta (Bitter)	Laghu (Light), Tikshna (Sharp)	Ushna (Hot)	-	VataKaphashamaka	Deepan (Digestive), Sanghrahi (Absorbing), Raktapitta

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							(Blooding disorder), Arsha (Hemorrhoids), Grahri (Digestive), Aadhman (Abdominal distension/bloating), Krimi (Worm), Shul (Pain)-Dah (Burning sensation)-Trisha Nashaka (Excessive thirst)
Trapush, Cucumber^{3]}	Karkati, Cucumber	Madhura (Sweet), Tikta (Bitter)	Guru (Heavy), Ruksha (Dry)	Sheeta (Cold)	-	Pittash amaka	Rochan (Appetizer), Grahi (Retentive), Triptikaraka (Satisfactory), Malmutrakar (Waste product producer), Raktapitta (Blooding disorder), Mutraroga (Urinary disease), Ashmari (Urinary calculi)-Murchha nashaka (Prevent fainting)
Dhanyak, Coriander Leaves^{34]}	Dhaniya, Coriander Leaves	Madhura (Sweet), Katu (Pungent), Tikta (bitter), Kashaya (Astringent)	Laghu (Light), Snigdha (Unctuous)	Ushna (Hot)	Madhur (Sweet)	Tridos hamak, Patra (Pittash amak)	Deepan (Appetizer), Rochan (Stimulates appetite), Pachan (Digestive), Grahi (Absorbent), Sroto Shodhana (Detoxification of channels), Mutrajanna (Urinary calculi), Shukra (Reproductive tissue), Jwar (Fever), Trishna (Desire for water), Daha (Burning sensation), Chhardi (Vomiting), Shwas (Dyspnoea), Kasa (Cough), Arsha (Hemorrhoids), Kriminashak (Kills worms and microbes)
Saindhav Lavana^{30]}	Sendhav, Rock Salt	Lavana (Salty)	Laghu (Light), Snigdha (Unctuous), Sukshma	Sheeta (Cold)	-	Tridos hshamaka	Vrishya (Enhances Sexual potency), Swadu (Tasty), Deepana (Enhances digestive fire), Pachana

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			(Subtle)				(Digesting), Rochana (Appetizer), Avidahi (Not causes any kind of burning sensation), Chakshushya (Good for eyes), Hridha (Good for Heart), Vrana (Ulcer/wound) Malstambha (Constipating), Hidroga nashak (Cure cardiac disease)
Nimbuk, Lemon ^[35]	Neemboo Lemon	Amla (Sour)	Laghu (Light), Tikshna (Sharp)		-	Vatash amak, Tridos hshama k	Pachana (Digestive), Deepana (Appetizer), Visuchika (Bloody diarrhoea), Udarshul (Abdominal pain), Krimi (Worm), Malbaddhta (Costipation), Mandagni (Low digestive fire), Vishnashak (Anti- toxic)

DISCUSSION:

Foxnut/Makhana (Popped form) is most commonly used as a dry fruit, apart from being used as salty roasted makhana or instant makhana porridge. It is believed that use of Foxnut in daily diet is beneficial for increasing the humoral and cell-mediated immunity to some extent ^[36]. According to Ayurveda, it balances doshas and maintains health. One of Ayurveda's unique concepts is Ahara Kalpana (food preparation) and properties of a dravya (substance /food article) can be altered with the help of Ahara Kalpana. According to Acharya Charaka, Ahara Kalpana is beneficial for both Rugna (sick) and Swastha (healthy people). It comprises the choice and preparation of food items based on the particular demands of patients and conventions from specific dravyas ^[37]. Acc. to Bhavprakashnighantu, Foxnuts can be consumed raw or roasted. When roasted in hot sand, they puff up. Makhana flour is like arrowroot flour. It is often cooked with milk and given to postpartum women and also children. It is easily digestible and highly nutritious, making it suitable as a regular food ^[5]. In today's time, we can use different types of cooking methods to appeal to taste and flavour and to improve palatability. So that we can use makhana, like, in Makhana Drink, Makhana Barfi and

Makhana Salad etc. Because of its possible health benefits, it has been utilized in traditional medical systems, including Ayurveda and traditional Chinese medicine. The astringent properties of foxnut can benefit G.I. problems, especially minimizing diarrhoea. In Ayurveda, it is indicated to treat the conditions related to diarrhoea with excessive mucus. Foxnut contains bioactive chemicals that may have anti-inflammatory qualities ^[38]. Because of their low-calorie content and high fiber content, foxnuts are occasionally suggested as a snack for people trying to control their weight ^[39]. It has well-known nutritional advantages, particularly its high antioxidant content, which includes flavonoids and phenolic compounds that are known to fight oxidative stress, a major contributor to degenerative and inflammatory diseases. Foxnuts' antioxidants may help the body fight off dangerous free radicals, lowering the chance of developing chronic illnesses ^[38].

CONCLUSION:

This review provides an overview of the many advantages of foxnuts in treating a variety of diseases. Additionally, through different Ahara Kalpana, this article discusses the nutritional and

medicinal potential of foxnuts from the perspectives of Ayurveda and modern aspects of nutrition. It exhibits numerous bioactivities, including antioxidant, antidiabetic, anti-fatigue, anti-ageing and anti-melanogenic activities. Euryale, both raw and popped, contains essential amino acids for healthy bodily function. According to Ayurveda, foxnut possesses Kashaya (astringent) and Madhura (sweet) rasa, along with Sheeta (cooling) virya. It enhances Vata and Kapha while balancing Pitta, Ruksha (Dry) and Grahi (Absorbent) and is also easy to digest. It has the properties of astringent, laxative and absorbent and while it is cooked in milk and the preparation is given to people suffering from postpartum haemorrhage, during ovulation and in cases of alopecia. It is easily digestible and can be used as a dietary supplement. Adding foxnuts to dietary routines may be a useful way to solve current nutritional problems and promote health. To completely comprehend its potential benefits to global food security, sustainable agriculture and human health, more investigation and study are necessary.

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