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Horsegram (Macrotyloma uniflorum): Medicinal importance in perspective of unani medicine and pharmacological studies.

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ABSTRACT :

Macrotyloma uniflorum, commonly known as 'horsegram,' is an annual erect herb belonging to the Fabaceae family. Locally referred to as 'kūlthi or hābbūl qilt. It is cultivated in India for Horse feeding purposes and can be found growing from near sea level to 1800m. In traditional Unani Medicine, the seeds and roots of Macrotyloma uniflorum are utilized for treating various health conditions, including Nephrolithiasis, Antidiabetic, Antiinflammatory, Ammenorhoea. Macrotyloma species, including Macrotyloma uniflorum, contains a diverse array of phytoconstituents such as Vanilic,caffeic, alkaloids, phenols, and flavonoids. Numerous pharmacological studies have been conducted on this plant, revealing its antilithiatic, hepatoprotective, antiobesity, antidiabetic, anti-bacterial, emmenagogue, antioxidant and antimicrobial properties. This paper aims to shed light on the therapeutic applications of Macrotyloma uniflorum,based on both traditional Unani literature and scientific studies conducted on different parts of the plant.

Keywords: Macrotyloma uniflorum; Horsegram; Nephrolithiasis; Kūlthi; Unani Medicine.

1. Introduction-

The immence variety found in the plant kingdom offers a wealth of new compounds with significant medicinal benefits. Presently, there's a growing interest in underutilized legumes to address the rising demand for vegetable protein as alternative protein sources [1].One such medicinal plant mentioned in traditional Greek medicine is horsegram named as kūlthi or Hābbūl qilt. Horsegram is the fifth most widely grown pulse species in India [2].
Among approximately 25 species of horsegram found in Africa, Asia and Australia[3]. Four varieties of horse gram have been distinguished:
M.uniflorum - var.uniflorum
M.uniflorum - var.stenocarpum
M.uniflorum - var.verrucosum
M.uniflorum - var.benadirianum[4]
Africa serves as the main origin center for this crop. In Asia, cultivation is predominantly found in countries such as India, Malaysia, Myanmar, and Nepal. While it is cultivated in many states across India, the bulk of the crop (90-95% of the area) is concentrated in five major states: Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, and Orissa[5]
Horse gram, scientifically known as Macrotyloma uniflorum, is an annual plant of the legume family Fabaceae. Rich in protein, it is an underutilized crop, often overshadowed by cereals despite being the second most significant class of crop plants essential for a balanced human diet. Additionally, it serves as feed for cattle, both in fresh and dried forms, benefiting dairy and poultry animals [6]. Horsegram name originates from its use as an important feed for horses[5]
Horsegram is a slender, twining annual herb with cylindrical tomentose stems [3].Horsegram is horizontal or partly erect, annual, or perennial herb of about 30–50 cm and normally has long runners. The leaves are alternate, stipulate, petio-late, and trifoliate and 2.5–5 cm in length, and leaflets are membranous entire, pilose, ovate, and acute. The stipules are ovate, lanceolate, and minute. It produces one to three greenish yellow-colored flowers in the leaf axis. The flowers are bisexuals, bracteates, bractealate, pedicellate, hypogynous, zygomorphic, complete, and pen-tamerous[8]. The seeds are oblong or round, and its color varies from pale to dark reddish brown or reddish black and orange-brown. The crop takes 3 to 4½ months to mature depending upon the variety[7].The seeds of M. Uniflorum harbor bioactive compounds like phytic acid, phenolic acid, fiber, and enzymatic/proteinase inhibitors, which exert notable metabolic and physiological impacts [1]. Horsegram is a versatile crop and can be grown from near sea-level to 1800m [3]
It is a traditional tropical grain legume, well known for its hardness and adaptability to poor soils and adverse climatic conditions that may prove unsuitable for most of the other crops [5].South India is known for various tasty preparations out of this legume, such as curry, pappad and so on.In many parts of South India, horsegram is grown as preparatory crop in newly reclaimed lands to improve the soil fertility by fixing nitrogen and increasing organic matter status through shedding of leaves[5].
Horsegram has been grown under number of intercropping systems. It is a short duration crop, hence it can be rotated with number of crops. Crop can be intercropped with various cereals namely sorghum, maize, pearl millet depending upon the season, soil fertility and genotypes. Intercropping of groundnut (2 rows) and hybrid sorghum (2 rows) with horsegram has been reported profitable without affecting the total income per unit area.South

India is known for various tasty preparations out of this legume, such as curry, pappad and so on[5].Panch dhani is a mixture of 5 crops (horsegram + Indian bean + cowpea + niger + castor) grown by Karnataka farmers which is a common practice to combat drought and use hosegram and other crops.
Horsegram is known for medicinal (diuretic properties) and it is said to be good for patients suffering from urinary and kidney problems.It is supposed to have medicinal value especially in dissolving stones[5].Sprouts of Horse gram are used in eliminating kidney stones[4].
By consuming the soup prepared from sprouted horsegram, one can get better sleep. In ladies irregular monthly periods and urniary problems can be overcome by consuming the grains daily. Grains are also helpful in whooping cough.Constipation can be avoided by drinking a cup of horsegram soup with a small quantity of lemon juice and salt. In kerala its dal is believed to be good for rheumatic patients[5].
Numerous pharmacological studies have explored the therapeutic potential of horsegram, revealing a range of effects such as Antilithiatic, emmenagogue, Antiobesity, Anti microbial, Antioxidant, Larvicidal, Hepatoprotective properties.
The aim of this paper is to emphasize the therapeutic applications of Macrotyloma Uniflorum drawing from description in Unani literature and scientific studies conducted on the plant.

2. Materials and Methods

In the context of Unani medicine, a comprehensive literature review was undertaken by searching all accessible classical textbooks using key terms such as Krotha, Kulattha, Kulathika, Sweet beeja, Kulth, Kollu, Horsegram, Madrasgram, Poorman's pulse Kuthi, Habbul Kulth, and Bian Dou. Additionally, electronic databases such as Google Scholar, ResearchGate, and PubMed were searched for terms such as horsegram, hābbūl qilt, and so on. The search covered both ancient Unani terminology and botanical nomenclature. Data gathering and subsequent analysis involved thorough consideration of review articles and experimental investigations. This rigorous method sought to gather essential material from both traditional Unani sources and contemporary scientific research, resulting in a comprehensive analysis of horsegram's therapeutic applications and qualities in the context of unani medicine.

3. Observations

3.1 Geogaphical Distribution-

Horse gram is distributed throughout tropics and is reported to be cultivated in India, Myanmar, Nepal, Malaya, Mauritius, Westindies. Crop being a native of India, is cultivated mainly in dry regions of Asia and Africa. Africa is the primary centre of origin. In Asia, crop is mainly cultivated in India, Malaysia, Myanmar, Nepal. It is grown in majority of indian states but 90-95% area of crop is confined to 5 major states namely In India it is widely grown in Tamil nadu, Karnataka, Andhra Pradesh, Maharashtra, Orissa[5].While it has been reported in small extent at Rajasthan, Maharashtra and Madhya Pradesh[19].It is cultivated upto 5000ft elevation in Himachal Pradesh and Nepal[5].

3.2 Soil and Climate

Horsegram can be grown in deep red, loamy, sandy, stony, gravelly soils.However light sandy soils are better for crop cultivation.Crop can be easily grown on soils having low nitrogen and organic matter to reclaim the poor soil fertility.It requires average temperature 18-32C to grow but in drought prone areas it can tolerate temperature upto 40C. Horsegram is a short day plant and requires 12 hours sunlight to flower. Horsegram is grown under varied rainfall 300-500nm, altitude(0-3N), Temperature (20-35C).
Horsegram is grown under wider duration from july to October in different parts of country[19].Seeds sown in first fortnight of august and September had higher grain and straw yields as compared to crop sown in first fortnight of October [19] .Crop is successfully cultivated during both Kharif and Rabi seasons in south indian states.

3.3 Nomenclature (Wajeh Tasmiya)

Initially horsegram was included in the genus Dolichus by Linneaus but Verdcourt reorganized the different species formerly assigned to Dolichus and assigned the genus Macrotyloma to horsegram[2]
The name Macrotyloma is derived from Greek word markos meaning large,Tylos meaning Knob and Loma meaning margin with reference to knobby statures on the pods[3]

3.3.1Taxonomical Classification[19]

- Domian - Eukaryota
- Kingdom - Plantae
- Sub Kingdom - Viridiplantae
- Phylum - Magnoliophyta
- Sub Phylum - Euphyllophtye
- Class - Magnoliopsida
- Subclass - Rosidae
- Order - Fabales
- Family - Fabaceae

- Subfamily - Faboideae
- Tribe - Phaseolaceae
- Genus - Macrotyloma
- Species – Uniflorum (L) Verdc.

3.3.2Vernacular name (Mutradif) [1]

- Kashmiri-*Krotha*
- Sanskrit - *Kulattha,Kulathika,Sweet beeja*
- Punjabi: *Kūlth*
- Tamil Nadu - *Kollu*
- English name - *Horsegram, Madrasgram , Poormans pulse*
- Hindi name - *Kūlthi*
- Arabic name - *Hābbūl Kūlth*
- Chinese name – *Bian Dou*

3.4 Unani Description

Horsegram is cultivated mainly in South Indian states; Andhra Pradesh, Mysore, Madras[20] ,Rajasthan, Srilanka and Burma [13].It is a type of pulse.Cultivated horsegram is called *Hab-ul-qilt* while as wild horsegram is called *Chaksu or Ban Kūlthi* [15].Plant height is 1.5-2feet.Leaves resemble that of ard plant;three leaves joined together i.e trifoliate[13].Plant bears pods as that of pea which are 4-5cm in length containing 5-6grains.These seeds possess medicinal value. These seeds are used as fooder for horses that's how it got its name as horsegram[20 14].Grains are flattened ,shiny as that of *masoor* and when broken into two cotyledons is white in colour. Colour of grains svary.Some varieties are black, bluish whitish, white yellowish, black reddish [14 15 16] 12g of grains yield 56g flour and 2g oil [15]

3.5 Morphological Characters [1]

Part	**Characters**
Habit	wining, sub-erect annual,60 cm tall in pure stands, or 60–90 cm with support framework
Stem	with cylindrical, slightly hairy to tomentose stems
Leaves	about 3.5–7.5 cm long, trifoliolate; stipules 7–10 mm long
Leaflets	acute or slightly acuminate, ovate, rounded at the base. Terminal leaflet symmetrical, laterals asymmetrical. 2–4 cm broad, fimbriolate. Softly tomentose on both surfaces and paler beneath
Petiole	2.5 cm long
Flower	panicles, nodding, bisexual, 3 stamens having spikelets usually having one flower which is jointed on very short stalks.
Calyxes	10.5 mm long, 7–8 mm broad, shaped in standard oblong. Wings about as long as the keel, 8–9.5 mm long
Pod	about 2.5–6 cm long, 6 mm broad, slightly curved, smooth or tomentose, linear-oblong, with a point about 6 mm long and shortly stipitate
Pedicles	0.3-0.5 cm long
Bracts	lanceolate-linear upto 0.4 cm long
Seeds	ovoid in shape, 4–6 mm long, 3–5 mm broad. Colored with pale fawn, light red, brown, or black. Decorated with faint mottles or with small, scattered black spots with hilum central. Each pod contains 5–8 seeds, One kilogram contains about 33,000–75,000 seeds
Microscopic features	i. Testa: Epidermis is single layered, thin walled and shining cells because mucilage in this layer. ii. Endosperm: Endosperm form bulk of the seed with thick walled

	polygonal parenchymatous cells. iii. Alueron: Outer portion of the seed contains alueron grains which are protein in nature. iv. Embryo: In the mid of the seeds, embryo can be seen which provide nutrition	

Fig 1 Showing a.Fresh plant b.Dried plant c.Different species of seeds having yellow black and brown seed coat. [17]

3.6 Ajzā-i-Musta'mala (Parts Used)

Seeds and Root of Macrotyloma Uniflorum [15]

3.7 Mizāj

Hot and dry (2nd) [14 15]
Hot(3rd) and Dry (2nd) [13 16]
As per sheikh and masarjoya Cold (2nd) and Wet (Ist)

3.8 Miqdār Khūrāk (Dose)

3g [15]
3-5g [13 14]
1.5- 2g [16]
Root- 72mg [15]

3.9 Maḍarrat (Adverse Effects):

Lungs [13 14 15 16]
When used as food (dal) can cause burning sensation in stomach and increase in safra(bilous) [15]
Decreases eyesight [15]

3.10 Musleh (Corrective):

Honey [13 14 15]
Honey, *Tukhm shaljam, aab barg turb* [16]
For root: milk

3.11 Badal (Substitute):

Hajrul yahood, Alsi [16]
Alsi [15]
Tukhm e chaksu [14]
Tukhm e kataan [13]

3.12 Nafah khas (Main Action)

Mukhrij sang gurdah,Diuretic, Hemorrhoids[16]

3.13 (Af'āl)Action:

Lithotriptic [13 14 15]
Emmenagogue [13 14 15]
Diuretic[13 14 15]
Phlegm remover
Carminative
Laxative
Mujafif [14]
Deobstruent
Brightens complexion[13 15]
Appetiser
Antiperspirant
Abortifacient
Antihelminthic
Antitussive
Anaesthetic

3.14 Iste'mālāt (Therapeutic Uses)

Macrotyloma uniflorum has both antihyperglycemic and insulin resistance-reducing effects. Antihypercholesterolemic, antimicrobial, antiobesity, antihelminthic, analgesic, anti-inflammatory, antidiabetic, anticholilithiatic, antihistamine, anti-peptic ulcer, antioxidant, anti-obesity, anti-urolithiatic against calcium oxide crystals, calcium phosphate crystals, and uric acid crystals, diuretic, haemolitic, and hepatoprotective[4].

3.15 Phytoconstituents

Phenolic acids-3,4 Dihydroxybenzoic
4 hydroxybenzoic
Vaniilic
Caffeic
p-coumaric
ferulic
syringic
sinapic acids[4]

3.15.1Flavinoids

Cotyledon-kaempferol 6.0c
Quercetin 9.7
Seed coat Quercetin 129.5a
Kaempferol 117.2a

3.16 Pharmacological studies

Table 1 : Pharmacological studies on macrotyloma uniflorum 12

S.no	Activity performed	Method	Finding	Reference
1	Anti-allergic or Anti-anaphylactic Activity	Milk-induced leukocytosis, eosinophilia and passive paw Anaphylaxis	Rats pretreated with ethanolic extract showed substantial protection against degranulation.	(Suralkar., 2013)
2	Anti-HIV Activity	Docking was performed by two ligands, i.e., Dolichin A and Dolichin B with the three replication enzymes, i.e. reverse transcriptase, protease and integrase)	The result showed that the protease enzyme has more effective ability to dock with ligands Dolichin A and Dolichin B effectively than reverse transcriptase, protease and integrase.	(Auxilia et al., 2013
3	Larvicidal and Anorectic Activities	The aqueous extract of seeds of horse gram was prepared and used to check the anorectic activity (weight loss) of horse gram on five groups, i.e. LD, MD, HD, 5HT and NC in Albino rats.	The result showed that at low dose group, i.e., (5HT at a dose of 5 mg/kg) treated with horse gram extract had quicker action than the other groups.	Bhuvaneshwari, 2014)
4	Hepatoprotective Activity	The hepatoprotective effect in five groups of Wister albino rats were checked i.e., Group I: Control (Saline 5 ml/kg), Group II: Paracetamol (2 g/kg), Group III: Standard (Silymarin 50 mg/kg), Group IV: methanolic extract of horse gram seeds MEMUS (200 mg/kg), Group V: MEMUS (400 mg/kg). D-Galctosamine and paracetamol-induced hepatotoxicity in rats, i.e. damage of liver cell.	The methanolic extract of horse gram seeds (MEMUS) showed the significant hepatoprotective effect (95%) in Wister albino rats at the concentration of 400 mg/kg	(Parmar, 2012)
5	Protease Inhibition Activity	The protease inhibitors were purified from horse gram, and the concentration of inhibitor was 0.27 µg/ml to the tryptic enzyme and 0.46 µg/ml to the chymotryptic enzyme	Proteinase inhibitors play a significant function in controlling proteases	(Mehta, 1982) (Muricken, 2010)
6	Antihelmintic Activity	The ethanolic extract of horse gram seed was used to check the anthelmintic activity against adult Indian earthworm Pheretima posthuma resemblances with the intestinal roundworm parasites in anatomy.	The anthelmintic activity of the seeds of horse gram was found having good effect by comparing with standard piperazine citrate.	(Philip et al., 2009)
7	Anticalcifying Activity	In-vitro effect of the immature seeds of Dolichos biflorus on crystallisation of calcium phosphate shared significant results	They concluded that the anticalcifying activity was lost completely by treating with activated charcoal, which was not recovered or eluted by solvent.	Peshin , 2010)

8	Anti-inflammatory Activity	VRV-PLA2 (Viper arussellii snake venom PLA2) is used as an enzyme for anti-inflammatory activity	horse gram supplementation for 21 and 60 days indicated no significant variations in inflammatory mediators.	(Giresha et al., 2015)
9	Anticholelithiatic Activity	The gall bladder size was increased with the help of LG (Lithogenic diet) and then checked against both the extracts at different concentrations.	The aqueous extract group showed the lowest incidence of CGS (60.21%) and also significant (P<0.01) reduction of gall bladder weight at 300 mg/kg than the methanolic extract, i.e. 60.0%	Bigoniya et al., 2014
10	Antimicrobial Activity	The effects of different fractions of methanolic effect of the seeds of D.biflorus on some micro organisms were studied by Basak and Ghosh.	A few active principles isolated from seed extract with methanol showed significant action against some test organisms.	(Basak et al., 1994)
11	Antiobesity activity	The hot Extract of Dolichos biflorus (Horse gram) on Body Weight in Overweight or Obese Human Voluntee	The Macrotyloma uniflorum exhibited Significant antiobesity activity.	(Bhuvaneshwari et al., 2014)

3.16 1 Antimicrobial studies:

The methanol extract showed characteristic zone of inhibition against 5 pathogens including Psuedomonas,aeruginosa, Serretia sp., salmonella sp. E coli and kleibsella sp. among 9 test pathogens.While ethanol extract has only shown activity against klebsella sp. and Proteus sp, however zone of inhibition was very pronounced. [10]

Macrotyloma Uniflorum Seed Aqueous Extract (MUSAE) showed similar protein banding pattern in both reduced and non-reduced conditions on SDS-PAGE. MUSAE exhibited proteolytic activity as it hydrolyzed casein with the specific activity of 0.121units/mg/min. while, the proteolytic activity of MUSAE was totally eradicated by 1, 10-Pheanthroline and PMSF but EDTA and IAA did not; confirms the presence of serine and zinc metallo protease in MUSAE. MUSAE delayed the clotting time of human citrated plasma against the control 184sec to 407sec suggesting its anti-coagulant property. Interestingly, MUSAE delayed the clot formation process of only APTT, suggesting its participation in an intrinsic pathway of blood coagulation cascade. Furthermore, MUSAE hydrolyzed human fibrinogen, fibrin clot without hydrolyzing other plasma proteins. In addition, MUSAE exhibited antiplatelet aggregation property by inhibiting agonists ADP and Epinephrine induced platelet aggregation.[9]

Acute treatment with M. uniflorum ASE (12.34 g/kg) did not elicit any overt signs of toxicity (salivation, diarrhea, lacrimation, chewing jaw movements, yellowing of fur, loss of hair), stress (erection of fur and exophthalmia), behavioural abnormalities (biting and scratching behaviour, licking of tail, paw, intense grooming behaviour or vocalization) or mortality and morbidity[11].

3.16.2 Anti-Urolithiatic Activity:

The impact of oral administration of aqueous and alcohol extracts of Macrotyloma uniflorum (Fabaceae) seeds on calcium oxalate urolithiasis was investigated in male albino wistar rats. Feeding with ethylene glycol caused hyperoxaluria as well as increased renal calcium and phosphate excretion. Supplementation with aqueous and alcohol extracts of Macrotyloma uniflorum seeds dramatically lowered high urinary oxalate levels, indicating a regulatory effect on endogenous oxalate production. Curative and preventive treatments with aqueous and alcohol extracts considerably reduced the increased deposition of stone-forming components in calculogenic rats' kidneys. The results reveal that the seeds of M. uniflorum are endowed with strong antiurolithiatic activity, and that the alcoholic extract of M. uniflorum shows better anti-urolithiatic activity than aqueos extract[4].

AEMU has showed a significant diuretic activity at the dose of 400 & 800 mg/kg (10.97 _ 0.06 ml & 16.06 _ 0.09 ml/100 g/6 h) as compared to normal group (8.51 _ 0.26 ml/100 g/6 h), furthermore, the effect of AEMU at dose of 800 mg/kg was also comparable with the standard diuretic agent, furosemide (14.08 _ 0.39 ml/100 g/6 h) [18]

Table 2: Therapeutic importance of horse gram imparted by various nutrients and bioactive compounds[17]

Nutrients and bioactive components of horsegram	Functional properties	Therapeutic properties
Proteins (Globulin,albumin,prolamines)	High proportion of essential amino acids	Reduce protein energy malnutrition,increase lean muscle mass & natural relaxant

Carbohydrates (a-amylase resistant starch & oligosaccharides)	Slow and gradual digestibility	Antidiabetic & prevent colorectal cancer
Lipids (Essential fatty acid)	Phytosterol esters	Anti ulcer activity & combat acute gastric ulceration
Enzyme inhibitors (Bowman-birk type inhibitors)	Anti inflammatory activities	Treatment of ulcerative colitis and multiple sclerosis
Dietary fibers (Soluble & insoluble fibre)	Reduction in serum cholesterol & glucose content	Decrease risk of CVS diseases, gastrointestinal disorders & constipation
Crystallizing inhibitors	Anti calcifying effect on calcium phosphate	Removal & cure of kidney stones
(Secondary metabolites) Polyphenols,tannins,falvinoids,saponins & alkaloids	Antioxidant & free radicals scavenging activities	Positive CVS effects, protection from UV radiation, arthritis, immune deficiency diseases & ageing.

Table 3: Unani compound formulations having Macrotyloma uniflorum seeds as one of the ingredient, mentioned with their dose,method of administration, and indications15

Name of Unani Compound Formulation	Part used	Dose and Form	Indications
Safuf Hajral yahood	Seeds	7 g *safuf* with *Sharbat gokharu*	Lithotriptic
Sharbat-e- Barg Angoor	Seeds	30ml with water twice a day after meals	Useful in Nephrolithiasis and helps in removing kidney and bladder concretions
Majoon-e-Sang-e- Sarmahi	Seeds	7-9g with *Arq gaozaban*	Lithotriptic
Majoon Hajrul yahood	Seeds	9g with water	Lithotripic
Dimad (Paste)	Seeds	Use with *Roghan Gul* and *Moom zard*	Inflammation of stomach, Bladder, Uterus, Orchitis
Arq khabsul hadeed	Seeds	72-108ml	Chronic bladder ulcers
Qatoor	Seeds	As per required	Expulsion of kidney and bladder stones
Tabeekh	Seeds	Used with Arq jawansa	Acts as Analgesic in kidney and bladder pain
Matbookh	Seeds	Used with Roghan badam sheeren	Nephrolithiasis
Majoon hajrul yahood	Seeds	9g	Lithotriptic
Tiryaq mathana	Seeds	4.5g with milk	Obstruction of ureter

4. Conclusion

According to Unani Medicine, horsegram has numerous medicinal properties. Research indicates that this plant has promise for antilithiatic, anti-diabetic, anti-helmenthic, anti-obesity, anti-inflammatory, hepatoprotective, and antibacterial properties.

The plant's therapeutic potential stems from bioactive compounds present in its numerous sections, including the root and seed. Compound formulations of Horsegram are used in Unani Medicine to treat genitourinary problems like nephrolithiasis and female reproductive system related problems.Additional research is needed to uncover the plant's unique features and possible therapeutic applications in various health conditions.

Consent and ethical Approval

It is not applicable

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Competing interests

The authors have stated that no competing interests exist.

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