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A review on Horse gram (*Macrotyloma uniflorum* (Lam.) Verdc.) a valued pulse crop as a source of protein amongst the tribal community of Jharkhand

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Abstract- Traditional and tribal food grains and pulses are ancient and time-tested food considered as the best and unique in flavor, always fresh and is loaded with locally available/made ingredients connected to nature, and best in taste. Horse Gram (*Macrotyloma uniflorum*), popularly known as Kulthi dal is amongst one of the examples of the same. In Jharkhand, the pulse is versatile and cosmopolitan in adaptation. The legumes grow under adverse climatic circumstances and are capable of withstanding climatic challenges. The pulse is rich in nutrient like protein, phytic acid and phenolic acids which are significant in impacting many metabolic and physiological activity of the human health. Therapeutic investigation suggests that it can prevent kidney stones, piles, urinary illness, cold, throat infection, etc. The present review paper aims to review the food and pharmaceutical values and other values of Horse gram (*Macrotyloma uniflorum*).

Keywords: Horse gram, Nutrient, Bioactive compound, Tribal community, Jharkhand.

INTRODUCTION

Horse gram is an underutilized legume crop across the states of India is however the one of the highly preferred legumes used as pulse amongst the tribal community of the State of Jharkhand. The legumes grow under adverse climatic circumstances and are capable of withstanding climatic challenges. The pulse is rich in nutrient like protein, phytic acid and phenolic acids which are significant in impacting many metabolic and physiological activity of the human health. Therapeutic investigation suggests that it can prevent kidney stones, piles, urinary illness, cold, throat infection, etc..¹ It is widely cultivated in India including the states of Karnataka, Odisha, Chhattisgarh, Jharkhand, Andhra Pradesh, Tamil Nadu, Rajasthan and Uttarakhand. It is popularly known as the poor-man-pulse and is available

in highly affordable prices. In Jharkhand it is cultivated on 0.25 lakh hectares, with an estimated production of 0.195 lakh tons, with an average yield of 780 kg/ha. The low yield of the crop can be attributed to its wide range of cultivable location and high infestation of the pest and diseases leading to low and very irregular source of revenue generation. The legume is the most recommended to the community susceptible to hypoproteinemia.² It has high content of non-digestible carbohydrates which help to release the carbohydrate more gradually thus controlling high glucose spike and help in marinating admissible glycemic index amongst the diabetic patients.³ This legume is regarded as a healthy food because it contains 23% protein, less than 1% fat and 60% carbohydrates.¹ The present manuscript backs about the in-depth choice of Horse gram (*Macrotyloma uniflorum* (Lam.) Verdc.) a valued pulse crop as a source of protein amongst the tribal community in the state of Jharkhand.

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METHODOLOGY

Source of Data:

1. Primary Data: Field Survey

- Observation
- Random interview (face to face) with in the farmers, local market vendors and community belonging to marginalized section of the society

2. Secondary Data: Review of Literature

- Books
- Journals
- Internets
- Other

RESULT & DISCUSSION

Traditional and tribal food grains and pulses are ancient and time-tested food considered as the best and unique in flavor, always fresh and is loaded with locally available/made ingredients connected to nature, and best in taste. Horse Gram (*Macrotyloma uniflorum*), popularly known as Kulthi dal is amongst one of the examples of the same.

In Jharkhand, the pulse is versatile and cosmopolitan in adaptation. It is grown in extreme of climate but is disposed to the hands of various types of pests and disease in different climatic conditions, contributing to its low yield and productivity. Furthermore, it is cultivated on nutrient-deficient upland soils, where the cultivators stick to the conventional cultivation practices and low nutrient

application and management. This situation in return results in low revenue generation and widespread adaptation with many failure stories.⁴

The plant belongs to the family of Fabaceae, Genus of *Macrotyloma* and Species *M. uniflorum*. Horse gram is a twining annual or perennial which forms dense growth to a 30-60 cm in height. The leaves are trifoliate, 3-7 cm long and 2-4 cm wide.⁵ Leaflets are ovate, rounded at the base, pointed or slightly tapering, terminal leaflet symmetrical, laterals asymmetrical, 3.5-5 cm long, 2-4 cm broad, softly woolly on both surfaces, fimbriate, paler beneath. The flowers are born singly which are yellow or greenish-yellow in color. Pods are 6-8 cm long and 4-8 mm wide with 6-7 seeds. *Macrotyloma uniflorum* species is preferably cultivated for the wider shaped pods and better results. It is consumed as a whole seed as sprouts, or as whole meal. The plant is drought resistant but cannot withstand the waterlogged condition.

This diploid legume⁶ holds many nutraceutical properties which are useful in blood pressure regulated properties. It is useful in underdeveloped nations such as India, where the majority of the community is susceptible to hypoproteinemia, horse gram's nutritional value in the diet is exceptional.² In the classical Indian texts like Charak Samhita and Sushruta Samhita about traditional Indian medicinal system, the seeds of *M. uniflorum* are known to cure abdominal lump, bronchial asthma, hiccup, piles and also in regulating/stopping excessive perspiration.⁷

Table 1. Nutritional Composition (Macronutrient and Micronutrient) of Horse gram

Sl. No.	Nutrient	Nutritional Composition
Macronutrient (mg/100gm)^{9,10}		
1	Carbohydrates	58.86 ± 0.57 (Variety-AK 42) (Low content of carbohydrate makes them suitable to control the sugar spike in the diet).
2	Protein	21.06 ± 1.05 (Variety-AK 42) (rich in more Lysine than pigeon peas and chickpeas)
3	Fat	1.36 ± 0.05 (Variety-AK 42) (low amount oxidized fatty acids reduced the risk of lipid peroxidation which can lead to the cell damage and disease emergence)
4	Fiber	5.01 ± 0.19 (Variety-AK 42) (Pectin, gum, cellulose, hemicelluloses and lignin all together form the components of fiber which are cumulatively essential for a high fiber balanced diet).
5	Moisture	10.3 ± 0.21 (Variety-AK 42)
6	Ash	3.47 ± 0.01 (Variety-AK 42)
Micronutrient (mg/100gm)¹⁰		
1	Calcium	269 mg (High in calcium content amongst all the pulses make them suitable for the marginalized section of society to avail them in their dietary regimes)
2	Iron	876 mg (Fairly good content of Iron and molybdenum is good for the anemic patient).
3	Magnesium	152 mg
4	Phosphorus	296 mg
5	Potassium	1065 mg
6	Thiamine	0.32 mg
7	Riboflavin	0.24 mg
8	Niacin	1.82 mg

One of its common names “gahot” (especially in Kumaon and Garhwal regions of India), etymologically it meant to destroy kidney stones in the initial stage. Thus it can be attributed that these are useful in curing kidney stones.^{7,8}

In the state of Jharkhand especially amongst the tribal communities, the pulse is used and relish in form of cooked dal and are also used as fodder to feed the cattle. This crop is assumed to be a “Poorman’s pulse” which is designated as the “potential food source for future” by the National Academy of Sciences, United States.¹¹ The composition of macro-nutrients indicate that the pulse is rich in Carbohydrates followed by Protein, Fiber and Fat (Table 1) while in micro-nutrient the pulse is highly rich in Potassium, Calcium followed by Iron.

Presence of many anti-nutritional components present in this pulse makes them quite challenging in acceptance since they may decrease the process of nutrient absorption or the utilization in the intestinal processes resulting in the compromised metabolism while a very basic house hold level processing like soaking, de-husking, sprouting, heating and roasting results in reduction of such challenges. The local usually complain of facing longer cooking time of the pulse, else they relish and cherish eating them with the local culinary especially the cereals. Furthermore scientific investigation confirms that soaking of this pulse for about 12 to 18 hrs. is an optimum time period to reduce the levels of anti-nutritional chemicals such as phytic acid and proteolytic enzyme inhibitors that are entirely or partially dissolved in steeped water.¹² Apart from cooked pulses, locals relish this pulse in fritters and pickles, they often use salted namkeen, chutney with coriander leaf and garlic, “Bhapa” boiled and steamed whole grains and sometimes soups. Though there are various other products which can be prepared from horse gram which is needed to be tried and popularized in the culinary options (Fig. 1).

The manuscripts dedicated to the ancient traditional medicinal systems like *Charak Samhita* and *Sushruta Samhita*, also mention/marked the use of the seeds of *M. uniflorum* to cure abdominal lump, bronchial asthma, hiccup, piles and also in regulating/stopping excessive perspiration. The pulse has an array of therapeutic potential mentioned in (Fig. 2).

Low glycemic index or the low postprandial glucose response after the consumption makes it highly suitable for the diabetic patients. Research findings suggested that

the consumption of food item prepared from unprocessed raw horse gram seeds may be better than consuming their sprouts for the hyperglycemic people because sprouting significantly decreases the intestinal α -glucosidase. Based on the recommendation made, adding raw horse gram (not their sprouts) to the daily diet of diabetic individuals may be useful.^{13,14} An Alcoholic extract of horse gram seeds used in herbal formulation named “Lowat” is found effective in weight management which are capable in inhibiting adipogenesis and lipogenesis during the clinical trial on human subjects.¹⁵ The seeds, leaf extract of horse gram have also been reported to possess anti-obesity properties.¹⁶



Fig. 1- List of value-added products prepared from horse gram

The pulse is very famous in tribal folk medicine in reducing the risk of the kidney stones. The protein content of the pulses is reported of inhibiting calcium oxalate crystallization and was having abundant acidic amino acids.¹⁷ According to Ahmed *et al.*, (2016)¹⁸ the seed extract under *in-vitro* condition confirms the presence of inhibitors of crystallization which is water soluble, heat stable, polar, non-tannin and non-protein in nature.

Research further confirms methanolic seeds extract exhibited diuretic activity in the mice under the controlled laboratorial conditions.¹⁸ Furthermore, the methanolic seeds extract of horse gram also showed the fewer analgesics activity in mice.¹⁸

The aqueous extracts of horse gram inhibit VRV-PLA2 to a greater extent (90%) than the other extracts, i.e. ethanol, methanol, acetone, chloroform, benzene, and hexane. The aqueous extracts (100 μ g) of the seed coat

and seed pulp separately inhibited the VRV-PLA2 to 87.56% and 52.1% respectively. Furthermore, the aqueous extract successfully neutralized the indirect hemolytic activity and showed similar strength in counteracting the PLA2 induced mouse paw edema *in-vivo* conditions.¹⁹

Mice treated with ethanolic extract of horse gram showed the significant inhibition of milk-induced leukocytosis and eosinophilia.²⁰

The methanolic and aqueous extracts were prepared from seeds of horse gram and were examined for their bile anti-lithogenic potential on mice.²¹ Horse gram has also been used in the treatment of bacterial and fungal infections.²²

The seeds of *M. uniflorum* have an anthelmintic activity which can be beneficial in eliminating worms. The anthelmintic activity of the seeds of horse gram was found having good effect by comparing with standard piperazine citrate,²³ where it shows a very promising results when compared with standard piperazine citrate.

The methanolic extract of horse gram seeds (MEMUS) showed the significant hepatoprotective effect (95%) in Wister albino rats,²⁴ which shows that it has a potential of protecting the liver from the damage caused by the various factors like toxins, drugs and diseases.

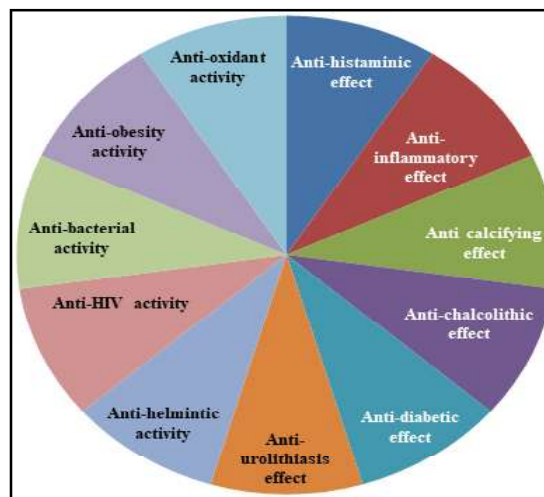


Fig. 2- Therapeutic potential of horse gram.¹

Table 2- Cultivation guidelines of Horse gram

Sl. No.	Cultivation Parameters	Specification
1.	Climate requirement	- Extremely drought resistant crop, cannot withstand the high altitude cool and wet climate. - Altitude of 100m and temperature ranged between 25-30 °C with 50-80% of relative humidity is optimum for growth of these pulses in cropping conditions. - Poorly aerated soil should be avoided and heavy rains in the initial stages are fatal.
2.	Soil Type & Field Preparation	- Grows in wide range of soil with low content of alkalinity. - Requires 1-2 plough followed by planking for seed bed preparation.
3.	Sowing -Time	- Late August-November. - During June-August for fodder. - Grown as Kharif crop in Central and western India.
4.	Seed Rate & Spacing	- Sown following broadcast method with 40 kg/ha seed rate. 40-45 cm of row spacing for the Kharif crop while 25-30 cm during Rabi crop is advisable.
5.	Seed treatment	- Seeds are treated with fungicide before sowing. - Carbendazim (bavistin) 2g for every kg of seeds is recommended. - Bio-fungicide like <i>Trichoderma viridi</i> is recommended.
6.	Fertilizer management	20 kg nitrogen and 30 kg P₂O₅ per ha is advisable.
7.	Water Management	Irrigation before flowering and pod formation stage is recommended.
8.	Weed Management	- Early weeding/hoeing is advised. - Application of Pendimethalin @ 0.75-1 kg a.i./ha to prevent pre-emergence of weed is advised.
9.	Plant Protection Measures - Causal Organism: Aphids or Jassids - Causal Organism: Pod borer - Causal Organism: Yellow Mosaic Virus vector-white fly - Causal Organism: Root rot	- Spray of Oxydemeton methyl 25 @ 1 ml/liter or Dimethoate 30 EC @ 1.7 ml/liter water. - Spray of NPV @ 250 LE/ha. or Quinolphos 25 EC @ 2 ml/liter water. - Spray of Oxydemeton methyl 25 @ 2 ml/liter or Dimethoate 30 EC @ 1.7 ml/liter. - Seed treatment with 2 g Captan or Carbendazim/ 2 kg of seed.
10.	Harvesting & threshing	Clean seed should be sun dried for 3-4 days to bring their moisture content at 9-10% to be safely stored.
11.	Storage	- It is recommended to fumigate the storing material before onset of monsoon and again after the monsoon with ALP @ 1-2 tablets per ton. - Protected by mixing inert material (soft stone, lime, ash, etc.) or by smearing edible/non-edible vegetable oils or by mixing plant products like neem leaf powder at the rate of 1-2% w/w basis.
12.	Yield	Harvest 6-10 quintal of grain/ha depending upon the monsoon behavior.

Source: <http://mkisan.gov.in>²⁵; <http://farmer.gov.in>²⁶

The α -amylase inhibitor from the seeds of horse gram showed the larvicidal potential against larvae of *Aedes aegypti*.²⁷ Dolichin A and Dolichin B (isomers of 3, 9-dihydroxy-10-(2'-hydroxy-3' methyl-1-3'-butenyl) are two pterocarpans extracted from horse gram. These pterocarpans constitute the second largest group of natural isoflavonoids with anti - HIV activity.¹⁵

Horse gram is an important legume, which is grown in all arid regions of the country without any scientific, agronomic and plant protection inputs. No doubt it is a hardy, nutritive and medicinally important food crop which are still not adopted and cultivated in a commercial basis across all the dried states of the country. The crop was adopted way back by the tribal communities of the state of Jharkhand but still it is not popularized in all day or day to day culinary plates. In the state of Jharkhand, the farmers are still skeptical for its large-scale cultivation practices because of its fragmented and seasonal demands by specific communities only. The information related to its cultivation practices are specifically targeted to the farms and farmers of the arid region though the region with fairly similar geographical conditions with only certain environmental and infrastructural challenges and arrangement are not addressed properly.

Locally popular though failed an acceptance in a larger scale can be attributed to its longer period of cooking time and availability of many pulses which require a less time in cook and serving like in case of Mansur Dal and Moong Dal. Many people are also not acquainted as well as adopted to its rustic and earthy taste. More local and innovative culinary should be developed and encouraged in local markets for the creation of demands. Many lost tribal recipes made from this particular pulse should be revived and served for its adoption in larger scales.

The pulse has an array of therapeutic potential mentioned in (Fig. 2) requires a much long term clinical research and manuscript communication. The medicinal potential is required to be demonstrated at higher level laboratorial trail basis for its proper utilization in a balanced and sustainable pathway.

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