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EXPLORATION OF MEDICINAL IMPORTANCE OF AN UNDERUTILIZED LEGUME CROP, *MACROTYLOMA UNIFLORUM* (LAM.) VERDC. (HORSE GRAM): A REVIEW

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ABSTRACT: *Macrotyloma uniflorum* (Lam.) Verdc. also known as horse gram or Kulthi bean has been an underutilized legume crop with immense medicinal importance/potential. It is considered as a rich source of protein, vitamins, and minerals. It is characteristically known for its biotic and abiotic resistance, e.g., resistant to drought, salt, and insects. There are umpteen references available in the traditional medicinal system reverberating its medicinal significance. Its various bioactivities like anti-diabetic, analgesics, anticalcifying, anti-hypercholesterolemic, anti-obesity, antihelmintic, antioxidant, larvicidal and anorectic properties have already been reported. Despite being both sturdy and nutritive food crop, its consumption is very low. The present review attempts to compile medicinal uses of this crop to attract the people for its consumption. Its regular consumption not only adds to health benefits but also provides useful nutrition.

INTRODUCTION: Horse gram (*M. uniflorum* (Lam.) Verdc.) is an annual, herbaceous, protein-rich, underutilized legume crop belonging of family Fabaceae¹. After cereals, legumes are considered as the second most important class of crop plants which have been a vital component of a balanced diet for humans^{2,3}. It is also used as cattle feed (both fresh and dried) for dairy as well as poultry animals. Horse gram gains special importance in semi-arid regions as its requirement for water is very low. Further, the English name of “horse gram” is also derived from its feeding to horses⁴. It is commonly known as kulath, kulith, ulavalu, gahot, hurali, kollurmuthira, etc. in various parts of India.

It is mainly grown in Africa, Australia, Burma, India, Malaysia, Mauritius, and West Indies¹. It is generally considered as protein-rich poor man’s crop that grows well under dry conditions (low rainfall) and marginal soil fertility⁵. Since, it is also a rich source of protein, vitamins, and minerals; therefore it can contribute to fight against protein malnutrition in the developing world. In the developing countries like India, only a few conventional legumes dominate the pulse production. Therefore, to effectively eradicate the protein malnutrition, the underutilized legumes like horse gram have a great potential in the nutritional security of rural, tribal and underprivileged people⁶. The crop accounts for about 5-10% of pulses production in India and its annual production is about 0.65 million tones⁵. Since, horse gram has good nutritive potential, and it is fairly resistant to various abiotic and biotic stresses. It has also has been identified as a potential future food crop by the U.S. National Academy of Sciences (NAS, 1978).

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Its resistance to various pests/pathogens is attributed to a dual function of LOX protein like lectin and lipoxygenase⁷. Also, it has a higher production potential under salt stress conditions⁸.

In India, horse gram is known as a legume with ethnomedicinal values. It forms major portion of the diet of the rural people during drought and dry seasons⁹. Further, it is considered as an excellent source of dietary fiber, molybdenum, iron, calcium, other micronutrients and other bioactive phytochemicals^{10, 11, 12, 13}. 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 perspiration¹⁴. One of its common names “gahot” (Kumaon and Garhwal region), etymologically means to destroy kidney stones in the initial stage is attributed to its usefulness in curing kidney stones^{14, 15}.

Some of its pharmaceutically important properties include anti-hypercholesterolemic, anti-microbial, anti-obesity, anti-helminthic, analgesic, anti-inflammatory, anti-diabetic, anti-cholelithiasis, anti-histaminic, anti-peptic ulcer, anti-oxidant, anti-obesity, anti-urolithiasis, diuretic, hemolytic, hepatoprotective, anti-diabetic and anti-hypertensive properties.

Therefore, the present review is an attempt to compile the best available information in the scientific literature about the medicinal significance of horse gram. The aqueous extracts of the seeds of horse gram are used to cure acid peptic disorder (gastritis), bleeding during pregnancy, constipation, colic caused by wind, female diseases (leucorrhoea, menstrual troubles and post-partum excessive discharges), hemorrhagic disease, intestinal worms, kidney stone, piles, rheumatism etc.^{16, 17} Seeds contain plethora of bioactive compounds which exert medicinal/nutraceutical values and also play inhibitory role by reducing establishment of various diseases like coronary heart diseases, diabetes and obesity¹⁸. The present review outlines and underlines its major medicinal values.

Anti-diabetic Activity: Diabetes mellitus is associated with high glucose levels in blood and is a very common problem throughout the world. Horse gram possesses slowly digesting starch

which is considered to have low postprandial glucose response upon its consumption by people suffering from diabetes¹⁹. Further, it was found that the methanolic extract of horse gram legumes along with methanolic extract of green tea leaves (at a combined dose of 200 and 100 mg/kg respectively) was significantly effective in reducing serum glucose level and in treating streptozotocin in induced diabetic hyperlipidemia in rats after seven weeks treatment²⁰. Fasting blood sugar levels decreased significantly upon horse gram treatment (300 mg/kg body weight/day for 30 days) and the serum triglycerides and total cholesterol levels were also decreased significantly. Therefore anti-diabetic and anti-lipidemic effects of horse gram were suggested, and it was recommended to use horse gram as a daily diet adjuvant against diabetes mellitus and associated problems²¹.

The α -amylase inhibitor isolated from the seeds of Horse gram in streptozotocin-nicotinamide-induced the diabetic effect in mice²². The *M. uniflorum* amylase inhibitor inhibited both mice pancreatic and human salivary α -amylases. It also reduced the serum glucose level in treated diabetic mice. The minimum pathological changes were exposed in the treated diabetic mice as compared to the diabetic control in histological findings²². Further, it suggested that the consumption of food item prepared from unprocessed raw horse gram seeds may better than consuming their sprouts for the hyperglycaemic people because sprouting significantly decreases the intestinal α -glucosidase²³. Based on the recommendation made, adding raw horse gram (not their sprouts) to the daily diet of diabetic individuals may be useful^{21, 23}.

Anti-hypercholesterolemic and Anti-obesity Activities: A herbal formulation, LOWAT containing the alcoholic extract of horse gram seeds was found effective in weight management and was able to inhibit adipogenesis and lipogenesis clinical trial on human subjects²⁴. Besides the seeds, leaf extract of horse gram has also been reported to possess anti-obesity properties. Horse gram leaf extracts were found to have hypolipidemic and anti-hypercholesterolemic effects. The leaf extracts of horse gram were found to have strong activities against high-fat diet-induced hypercholesterolemia and obesity in rats.

Upon the consumption of horse gram leaf extracts for 5 weeks, decrease in total cholesterol (TC), triglycerides, LDL (low-density lipoprotein), VLDL (very low-density lipoprotein) and an increase in HDL (high-density lipoprotein) was observed. The ethanol extract of horse gram led to significantly higher fecal excretion of cholesterol amount than the water extract, and water extract led to a significant lowering of body weight than ethanol extract²⁵. Another study also reported the similar effect of leaf extract of horse gram leading to the enhancement of HDL with a simultaneous decrease in TC, triglycerides (very low density) and LDL in male albino rats on hypercaloric diet (administration of cholesterol for 40 days)²⁶. In a study on overweight human volunteers, it was found that the hot extract of horse gram possesses anti-obesity activity. However, its anti-obesity effect was found to act more quickly in males than females, and its magnitude of anti-obese activity was also found more pronounced in males²⁷.

Antiuro lithiatic and Anticalcifying Activities: In Indian folk medicine system, horse gram soup is well known for its property of reducing the risk of kidney stones. It was found that two or more inhibitors of crystallization of calcium phosphate (one of the major constituent of kidney stones) are present in the seed extracts of horse gram that are water soluble, heat stable and non-protein in nature. However, the decrease in anticalcifying activity has also been reported along with the maturation of seeds or upon their post-harvest storage²⁸. Therefore, soup of freshly harvested horse gram may be useful in the management of kidney stones.

Besides this report of the presence of not-protein inhibitors of calcium phosphate crystallization, a dimeric antilithiatic protein (98 kDa) was also purified from the seeds of horse gram that was capable of inhibiting calcium oxalate crystallization and was having abundant acidic amino acids²⁹. The protein was shown to have sequence similarity with a calcium-binding protein, calnexin of *Pisum sativum*. The extracts of horse gram were reported to possess anti-urolithiasis activity that was almost equivalent to cystone like marketed formulation for kidney stones³⁰. It was also found that the horse gram extract is highly effective in the dissolution of calcium oxalate crystals and decrease their particle size considerably³¹.

When a different type of horse gram seed extracts (aqueous, chloroform and benzene) were checked for their *in-vitro* anti-urolithiasis activity, the aqueous extract was found to have the highest dissolution of kidney stones as compared to the others³². However, Researchers reported that alcohol extract of horse gram seeds was more effective than aqueous extracts while checking their anti-urolithiasis activity in male albino Wister rats³³. The renal excretion of calcium and phosphate was increased in rats by ethylene glycol feeding. Supplementation with both the aqueous and the alcohol extract significantly reduced the elevated urinary oxalate. Therefore, the increased deposition of stone forming constituents in the kidneys of calcuogenic rats was lowered considerably by both the extracts, however more by the alcoholic extract than aqueous extract^{34, 35}.

The *in-vitro* effect of horse gram seeds on crystallization of calcium phosphate which is the major constituent of the kidney stone had been studied. The seed extract of horse gram contains the inhibitors of crystallization which is water soluble, heat stable, polar, non-tannin and non-protein in nature. The anticalcifying activity was found to be lost completely with activated charcoal which was not recovered or eluted by any solvent tried³⁶. The calcium-binding proteins (CBPs) in seeds of horse gram was studied and reported that CBPs plays a significant function in the prevention of kidney stone production. The recognized CBPs in this work may be applied as a curative agent in kidney stones and may lead to the formation of antilithiatic formulation³⁷.

Diuretic Activity: The ethanolic extract of horse gram was given to the rats orally at different doses of 400 mg/kg and 200 mg/kg using furosemide 5 mg/kg) as standard. The ethanolic extract at 400 mg/kg showed the significant diuretic effect and the different parameters, *i.e.* bicarbonates, chloride, potassium, sodium, and urine volume was reported³⁸. The methanolic seeds extract of horse gram exhibited remarkable diuretic activity in mice, *i.e.*, (1.33 ± 0.13) at 300 mg/kg and (2.66 ± 0.31) at 500 mg/kg which were highly significant as compared to drug Lasix (20 mg /kg)³⁴.

Analgesics Effect: The methanolic seeds extract of horse gram showed the fewer analgesics activity in

mice, *i.e.*, 84.6 ± 6.68 at the dose of 300 mg/kg and 92.2 ± 6.81 at 500 mg/kg which were not much significant as compared to reference drug Aspirin (36.4 ± 2.27)³⁴. The tail immersion and hotplate methods are mainly used to determine the analgesic effect. Opioid agents showed analgesic effect through spinal (μ_2 , k_1 , δ_2) and supraspinal (μ_1 , k_3 , δ_1 , σ_2) receptors³⁹. The enhancement of reaction duration in tail immersion and hotplate tests by *M. uniflorum* represent the analgesic effect that involves endogenous opioid peptides and also biogenic amines such as 5HT⁴⁰ and occurrence of flavonoids in the methanol extract of *M. uniflorum* may take part in antinociceptive effect⁴¹. The methanolic extract of the horse gram seeds indicated no sign of alteration in behavior or mortality up to 2000 mg/kg oral dose which represents therapeutic safety of the pharmacologically active doses. The methanolic extract of horse gram possessed both central as well as peripheral antinociceptive activity⁴². The analgesic activity was also studied by using acetic acid-mediated writhing, hotplate and tail flick tests of fixed oil of horse gram in mice. The four different groups were used for the study such as normal saline control (2 ml/kg), MUFO (2 ml/kg), MUFO (4 ml/kg), and standard acetylsalicylic acid (ASA 300 mg/kg). All findings were significant, although, delayed onset of action was noted in tail flick and paw edema methods⁴³. Furthermore, they inferred that fixed oil of horse gram possesses analgesic activity which may be associated with peripheral mode of action.

Anti-inflammatory Activity: VRV-PLA₂ (Viper arussellii snake venom PLA₂) is used as an enzyme for anti-inflammatory activity. 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*⁴⁴. Carrageenan is the chemical which induces the paw edema by inflammation in the albino rats. The 70% DME (methanolic extract of seeds of *Dolichos biflorus*) showed the 73% inhibition of paw edema at the

dose of 50 mg/kg after three hours⁴⁵. Researchers also studied the anti-inflammatory activity of fixed oil of horse gram in rats⁴³. The four different groups were used for the study such as normal saline control (2 ml/kg), MUFO (2 ml/kg), MUFO (4 ml/kg), and standard acetylsalicylic acid (ASA 300 mg/kg). They concluded that horse gram possesses anti-inflammatory activity in 2 ml and 4 ml/kg doses and may be linked with the peripheral mode of action⁴³. The effect of horse gram on inflammatory mediators was studied⁴⁶.

The experiment was done in two sets of rats in which they were fed with boiled and unboiled horse gram at a dose of 100 mg/100 g body weight, for 21 days and 60 days. The findings of these results suggested that horse gram supplementation for 21 and 60 days indicated no significant variations inflammatory mediators, *i.e.*, myeloperoxidase, tumor necrosis factor-alpha (TNF- α), nitric oxide synthase, cyclooxygenase, lipoxygenase, monocyte chemoattractant protein-1 (MCP-1), interleukin-1-beta (IL-1 β), *etc.* Moreover, these findings suggested the anti-inflammatory potential of horse gram in rats.

Anti-allergic or Anti-anaphylactic Activity: The ethanolic extract by cold maceration process was prepared, and then it was operated on mice and rats for anti-allergic activity using milk-induced leukocytosis, eosinophilia and passive paw anaphylaxis⁴⁷. The results revealed that mice treated with ethanolic extract of horse gram at the concentration of 280 mg/kg and 560 mg/kg showed the significant inhibition of milk-induced leukocytosis and eosinophilia. Rats pretreated with ethanolic extract showed substantial protection against degranulation. Furthermore, when the rats were pretreated with horse gram at the dose of 100, 200 and 400 mg/kg, there was the reduction in paw volume after 0.5, 1, 2, 3 and 4 time interval.

Anticholelithiatic Activity: The methanolic and aqueous extracts were prepared from seeds of horse gram and were examined for their bile antilithogenic potential on mice⁴⁸. The methanolic and aqueous extracts were used for the presence of phenolics, tannins, and flavonoids. In this study, the gall bladder size was increased with the help of LG (Lithogenic diet) and then checked against both the extracts at different concentrations.

Both extracts effectively reduced the formation of CGS (Cholesterol gallstones). 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%⁴⁸.

Antimicrobial Activity: Horse gram has been used in the treatment of bacterial and fungal infections⁴⁹. The different crude extracts of horse gram, *i.e.* dichloromethane, ethyl acetate, 1-butanol, and aqueous extracts were checked against the different bacterial and fungal infections *i.e.* *Bacillus subtilis*, *Bacillus cereus*, *Bacillus megaterium*, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, *Shigella dysenteriae*, *Shigella sonnei*, *Fusarium equiseti*, *Macrophomina phaseolina*, *Colletotrichum corchori*, *Diplodiatheo bromae*, *Curvularia lunata* and *Alternaria alternaria*. The zone of inhibitions shown by dichloromethane, ethyl acetate, 1-butanol, and aqueous extracts ranged from 11-16, 10-24, 10-14 and 10-12 mm respectively at a concentration of 500 µg/disc. The ethyl acetate showed good activities and dichloromethane showed the moderate antibacterial activities. However, the 1-butanol and aqueous extracts did not show any significant antimicrobial activities⁵⁰. The seed extracts from *M. uniflorum* had shown significant activity against *Bacillus subtilis*, *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*⁵¹.

Anthelmintic Activity: The seeds of *M. uniflorum* have an anthelmintic activity which can be beneficial in eliminating worms. 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 citrate⁵². Similarly, the *M. uniflorum* chloroform extract (MUC), *M. uniflorum* methanol extract (MUM) and *M. uniflorum* aqueous extract (MUA), the three extracts of seeds of horse gram exhibited the anthelmintic activity against *P. posthuma* by comparing with the standard albendazole. Among the extracts, methanol extract (50 mg/ml) took more time to paralyze and kill the worms. At this dose, the time

required to paralyze the worms was 68 ± 0.30 min and death was recorded at 83 ± 0.20 . Whereas the time required for paralyzing and killing the worms with standard (Albendazole) was 45.0 ± 0.45 and 55.0 ± 0.20 min respectively.

The activity of 100 mg/ml methanol extracts was almost equal to that of the standard drug. The potency of the extracts was inversely proportional to the time taken for paralysis/death of the worms. These extracts can be used in the cure of helminths infestations⁵³. Therefore, its use as food to eradicate worms from infants has been suggested⁵⁴. However such uses of horse gram are speculated merely on the bases of the resemblance of *P. posthuma* with the helminths as described⁵².

Antioxidant Activity: The *in-vitro* antioxidant activity of ethanolic seed extracts of *M. uniflorum* was reported⁵⁵. The ethanolic extract of horse gram showed a good improvement in anti-oxidant enzymes such as superoxide dismutase, catalase and increased glutathione concentration in rabbits⁵⁶. Researchers extracted the raw and dry heated seed samples of horse gram with methanol and 70% acetone respectively. The extracts were evaluated for different antioxidant activities such as α , α -diphenyl- β -picrylhydrazyl, FRAP, linoleic acid emulsion, $O^{\cdot-}$ and OH^{\cdot} . Among all the extracts analyzed 70% acetone extract showed high hydroxyl radical scavenging activity⁵⁷. Overall, all the extracts exhibited strong antioxidant activity. The different free radical scavenging activities of ethanolic leaf extract of horse gram showed good *in-vitro* analysis of antioxidant activity and was performed by various assays, *i.e.* superoxide radical scavenging assays, ferric reducing antioxidant power assay (FRAP) and reducing power assay. These radicals were useful in the inhibition of α -amylase and intestinal α -glucosidase mainly effective in the management of the diabetes mellitus.

The result showed the maximum DPPH radical scavenging activity of 55% at the concentration of 500 µg/ml, 63% for ABTS radical scavenging activity, 85% for hydroxyl radical scavenging activity, 67% hydrogen peroxide radical scavenging activity and 83% for nitric oxide scavenging activity. These free radical scavenging potential of horse gram may be used in the

treatment of various free radical-mediated disease like diabetes mellitus⁵⁸. The antioxidant activities by 50% methanol and 70% acetone extracts of raw, dry heated and pressure cooked seed sample extracts of horse gram (brown and black variety) were also checked with the help of reducing the power of free radicals, *i.e.*, DPPH, OH, and ABTS. All the extracts showed peroxidation inhibiting activity between 94 to 99% without any significant differences ($p < 0.05$) in the linoleic acid emulsion system at the concentration of 1 mg in the reaction⁵⁷. The antioxidant activity using DPPH free radical scavenging assay in seed coats of horse gram were checked and determined the antioxidant activity against B16F10 cell line. They further reported that ethanolic and water extract of seed coat of horse gram possess antioxidant activity against skin cancer⁵⁹. The researcher also in their studies analyzed the effect of horse gram for antioxidant activities. The experiment was done in two sets of rats in which they were fed with boiled and unboiled horse gram at a dose of 100 mg/100 g body weight, for 21 days and 60 days. They inferred that horse gram supplementation for 21 and 60 days enhanced the antioxidant enzyme activities, *i.e.*, glutathione peroxidase, superoxide dismutase and catalase⁶⁰.

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 cells. The methanolic extract of horse gram seeds (MEMUS) showed the significant hepatoprotective effect (95%) in Wister albino rats at the concentration of 400 mg/kg⁶¹.

The hepatoprotective activity of horse gram for 95% methanolic extract was evaluated against D-Galactosamine A, and paracetamol A mediated hepatotoxicity in Wister albino rats. The rats were divided into five groups, each comprised of six animals. The 95% methanolic extract at the dose of 200 mg/kg and 400 mg/kg produced a dose-dependent decrease in SGPT, SGOT, ALP and morphological characteristics in D-Galctosamine and paracetamol mediated hepatotoxicity in rats.

The histopathological analysis exhibited the hepatoprotective activity of the test extract.

The highest protection was reported in 400 mg/kg horse gram seed extract. The results inferred that horse gram seed contains significant hepatoprotective activity⁶¹.

Protease Inhibition Activity: The protease inhibitors were purified from horse gram, and the concentration of inhibitor was 0.27 $\mu\text{g/ml}$ to the tryptic enzyme and 0.46 $\mu\text{g/ml}$ to the chymotryptic enzyme. The inhibitor was stable at 37 °C between a pH of 3 to 11 and at 97 °C up to 5.0 pH only. This inhibitor was found to be resistant to the action of pepsin, subtilisin, and urea at 37 °C⁶². The seeds of horse gram contain multiple forms of Bowman-birk inhibitors (protease inhibitors). HGI-111 is the major inhibitor which contains seven disulfide bonds and making it stable to high temperature. HGI-111 acts as the inhibitor toward bovine trypsin and chymotrypsin²⁵. Proteinase inhibitors play a significant function in controlling proteases⁶³. Bowman-Birk type inhibitors (BBIs) are important for human health by their capability to reduce carcinogenesis^{64, 65} due to the intrinsic capability of BBI to retard serine proteases which take part in carcinogenesis⁶⁶. The BBIs have great anti-inflammatory activity against obesity and many degenerative and autoimmune diseases as well as⁶⁷.

Larvicidal and Anorectic Activities: The α -amylase inhibitor from the seeds of horse gram showed the larvicidal potential against larvae of *Aedes aegypti*. First of all, the inhibitor was purified by using ion exchange chromatography on a carboxymethyl cellulose column and then it was tested at a different concentration of 20, 60, 100 and 200 ppm. *M. uniflorum* α -amylase inhibitor showed a strong larvicidal effect at the concentration of 200ppm; however, it does not show the pupicidal and ovicidal activities²². 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. These five groups represent the infusions of horse gram extract in low, moderate and high doses. The result indicated 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 groups²⁷. The herbal formulation (LT10903F) that contained an aqueous-alcohol extract also exhibited on weight management by inhibitory adipogenesis and lipogenesis.

They also evaluated the safety steps towards a series of acute, sub-acute toxicity and genotoxicity studies in animals and cellular models⁶⁸.

Anti-HIV Activity: Dolichin A and Dolichin B (isomers of 3, 9-dihydroxy-10-(2'-hydroxy-3'-methyl-3'-butenyl) are two pterocarpan extracted from horse gram. These pterocarpan constitute the second largest group of natural isoflavonoids with 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 integrase⁶⁹.

CONCLUSION: It is concluded that Horse gram is a sturdy, nutritive as well as medicinal food crop which has been under cynical abhorrence for ages. Its present consumption status cannot belittle its numerous beneficial bioactivities. Our intransigent neglect of not categorizing it as major food crop needs to be allayed by projecting it as major pulse.

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