



**MACROTYLOMA UNIFLORUM (LAM.) VERDC. (PAPILIONACEAE):
A REVIEW OF MEDICINAL USES, PHYTOCHEMISTRY AND
PHARMACOLOGY.**

Salman Ahmed¹, Muhammad Mohtasheemul Hasan^{1*} and Zafar Alam Mahmood²

¹Department of Pharmacognosy, Faculty of Pharmacy, University of Karachi, Karachi-75270,
Pakistan.

²Colorcon Limited – UK, Flagship House, Victory Way, Crossways, Dartford, Kent,
DA2 6 QD- England.

Article Received on
26 Nov 2015,

Revised on 17 Dec 2015,
Accepted on 08 Jan 2016

***Correspondence for
Author**

**Muhammad
Mohtasheemul Hasan**
Department of
Pharmacognosy, Faculty
of Pharmacy, University
of Karachi, Karachi-
75270, Pakistan.

ABSTRACT

The present review shares an updated data on the botany, distribution, traditional medicinal uses, phytochemistry and pharmacology of *Macrotyloma uniflorum* (Lam.) Verdc. All provided information was obtained through Google Scholar, Pubmed, SciFinder, Scirus, Web of Science and a library search.

KEYWORDS: *Macrotyloma uniflorum*, botany, traditional uses, phytochemistry, pharmacology.

INTRODUCTION *Macrotyloma uniflorum* (Lam.) Verdc., is an annual or perennial herb, climbing, prostrate or rarely erect belong to family Papilionaceae. The name *Macrotyloma* is derived from the Greek *makros* = large; *tylos* = knob and *loma*= margin in reference to

knobby sutures on the pods.^[1] *M. uniflorum* is found in Africa, Australia, Bhutan, India, Indonesia, Myanmar, Nepal, Pakistan, Philippine and Sri-Lanka.^[2]

Scientific classification

Kingdom: Plantae

Family: Fabaceae

Subfamily: Faboideae

Tribe: Phaseolae

Sub tribe: Phaseolinae

Genus: *Macrotyloma*

Species: *uniflorum*

Synonym: *Dolichos biflorus* Auct. and *Dolichos uniflorus* Lam.

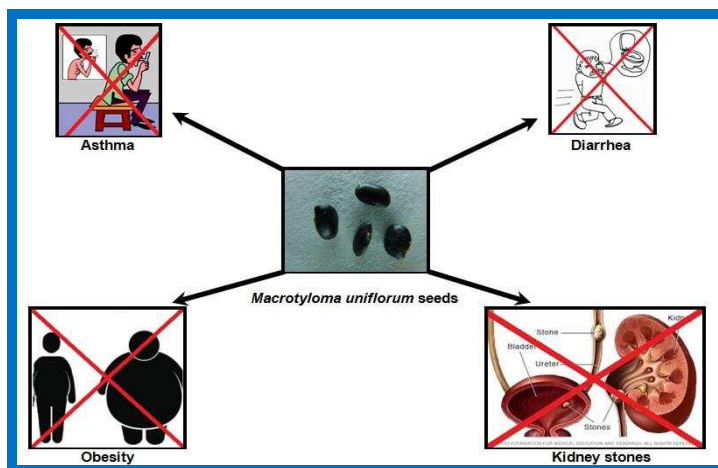


Table-1. Names of *Macrotyloma uniflorum* in different languages.^[3, 4]

Languages	Names
Bengali	Kurti-kalai
English	Horse gram, horse grain, kulthi bean, madras bean, madras gram, poor man’s pulse
French	Dolic biflore, grain de cheval
German	Kerderkorn, pferdebohne; pferdekorn
Italian	Dolico cavallino
Kumaon and Garhwal	<i>Gahot means</i> “which destroys stone at initial stage”
Latin	<i>Macrotyloma uniflorum</i>
Malyalam	Muthira
Portuguese	Faveira
Sanskrit	Kulattha
Spanish	Frojol verde
Tamil	Kollu
Telgu	Ullavallu

Table-2. Taxonomy.^[5]

Characters	<i>Macrotyloma uniflorum</i> (Lam.) Verdc.
Habit	trailing or twining annual herb, 30-90 cm high
Stem	slender, densely hairy
Leaves	3-foliolate, ovate-elliptic to rhomboid, cuneate at base, acute 5-foliolate, terminal one-stalked, ovate-lanceolate, or sub-acuminate at apex, 4-8 cm, softly appressed pubescent
Stipules	0.3 cm long, ovate-lanceolate, acute, scarious, 0.6-0.8 cm long
Petiole	2.5 cm long
Flowers	0.9-1.5 cm long, creamish yellow with purple spot, 0.6-0.8 cm long, blue-violet, in a auxillary racemes
Pedicels	0.3-0.5 cm long
Bracts	lanceolate-linear upto 0.4 cm long

Calyx	0.8-1.0 cm long, densely hairy
Corolla	0.6-1.2 cm long, vexillum with 2 larger appendages at base
Pods	falcate-recurved, densely hairy, 4.0-5.0 cm long, 4-6 seeded
Seeds	compressed, grey mottled, shining brown
Flowering and fruiting	August-October
Cultivation	cultivated up to 1800 m

Macro and microscopy of seeds^[6]

The seeds are roughly trapezoidal and flattish, with quite thin cotyledons. The hylum is small and linear and located in a small depression on the seed's lateral margin. The length of archeological specimens are usually 3.0-4.0 mm, width 2.0-2.6 mm and thickness 1.4-2.0 mm. Figure -1 showing the photograph of seeds. Microscopic evaluation gives the following 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.

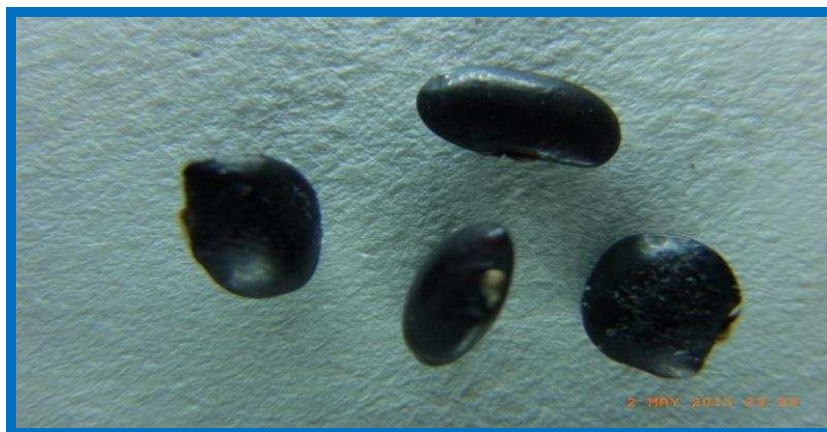


Figure-1: Seeds of *Macrotyloma uniflorum*.

TRADITIONAL MEDICINAL USES

In Indo-Pak subcontinent the seeds of *M. uniflorum* in traditional system of medicine are used for asthma, bronchitis, colic, diarrhea, dysuria, hepatomegaly, hiccup, kidney stones, leucorrhoea, obesity and splenomegaly.^[6, 7]

Table.3 Physicochemical parameters of the seeds of *Macrotyloma uniflorum*.^[6, 8, 9]

Physicochemical parameters	Reported value
Total ash	4.68% w/w
Sulphated ash	9.68% w/w
Acid insoluble ash	0.47% w/w
Water soluble ash	5.03% w/w
Emulsifying capacity	52.15- 52.60 %
Emulsion stability	48.20 - 50.32 %
Foaming capacity	38.16 - 45.0 %
Foaming stability	35.12 - 38.00 %
Oil absorption capacity	80.76 %
Swelling capacity	1.43 ml
Swelling index	0.46%
Water absorption capacity	135.80 - 142.14 g/100g
Water solubility index	7.56 - 7.60 %

Table-4. The nutritional value of the seeds of <i>Macrotyloma uniflorum</i>	
Category	Values
Basic composition(%age)^[8]	
Ash	3.34
Crude fat	1.30
Crude protein	18.15
Moisture	8.9
Total carbohydrate	15.59
Essential minerals(mg/g)^[9-12]	
Macro-minerals	
Calcium	1.01
Magnesium	0.40 - 1.90
Phosphorus	0.13 - 4.20
Potassium	2.63 - 14.78
Sodium	0.11 - 0.16
Micro-minerals	
Copper	0.006-0.020
Iron	0.06 - 1.79
Manganese	0.09 - 8.21
Zinc	0.02 - 0.07
Amino acids(% dry weight)^[13]	
Arginine	8.80
Cysteine	1.96
Histidine	3.15
Isoleucine	6.14
Leucine	8.96
Lysine	8.63
Methionine	1.16
Phenylalanine	6.31
Threonine	3.82
Tryptophane	1.16
Valine	6.47

Soluble sugar content g/100 dry matter ^[14]	
Arabinose	0.12
Fructose	0.03
Galactose	0.08
Inositol	0.04
Maltose	0.53
Oligosaccharides (inuline + raffinose +stachyose)	3.69
Sucrose	1.2
Xylose	0.64
Fatty acids(%age) ^[11]	
Linoleic acid	40.3 – 45.6
Linolenic acid	11.6 – 14.3
Oleic acid	8.9 – 16.8
Starch(g/100 g dry matter) ^[14]	
Total starch	36.0
Vitamins(mg/100gm) ^[13]	
Niacin (B ₃)	1.5
Riboflavin (B ₂)	0.09
Thiamin(B ₁)	0.42
Dietary fibers (% dry matter) ^[15]	
Cotyledon	16.7(T);15.38(I);1.32(S)
Embryonic axe	22.6(T);19.5(I); 3.1(S)
Seed coat	36.4(T);32.5(I);3.9(S)
Caloric value(kcal/g) ^[8]	4.31
Key: T= total dietary fiber; I= insoluble fiber; S=soluble fiber	

Table-5. Pharmacological activities of *Macrotyloma uniflorum*

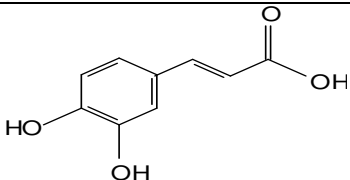
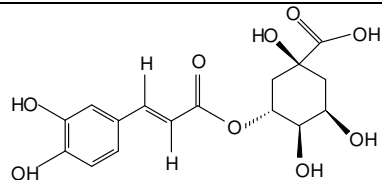
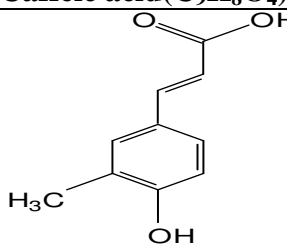
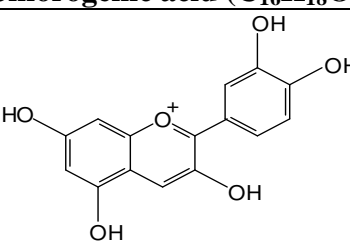
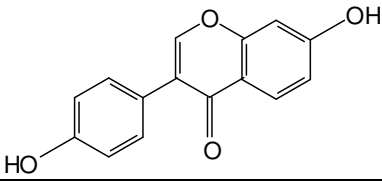
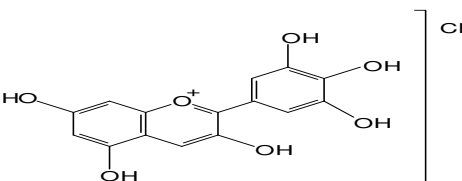
Part	Extract	Pharmacological activity
Plant	aqueous and ethanol	antihypercholesterolemic ^[16]
	ethyl acetate	antimicrobial ^[4, 17]
leaves	aqueous	antiobesity ^[18, 19]
	ethanolic	anthelmintic ^[20]
	methanolic	antidiabetic ^[21]
Seeds		analgesic and anti-inflammatory ^[22]
	acetone	anticholelithiatic ^[23]
	ethanolic	antihistaminic ^[24]
	hydroalcoholic	anti-peptic ulcer ^[25]
	chloroform, ethanolic and methanolic	antioxidant ^[26-28]
	alcohol	antiobesity ^[18, 19]
	aqueous	anti-urolithiatic against calcium oxalate crystals ^[29-32]
	antilithiatic protein	
	aqueous	anti-urolithiatic against calcium phosphate crystals ^[33]

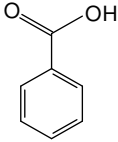
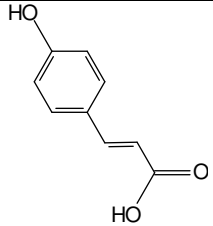
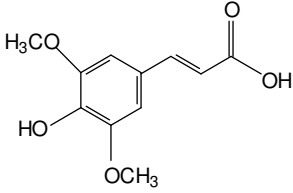
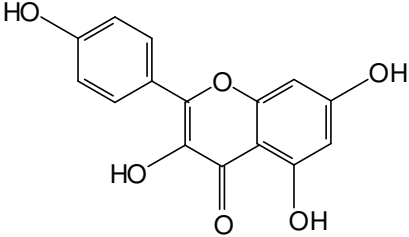
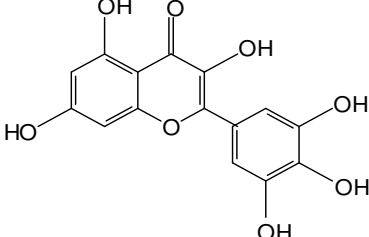
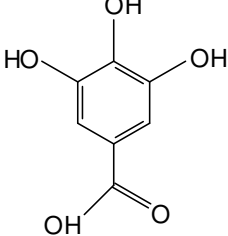
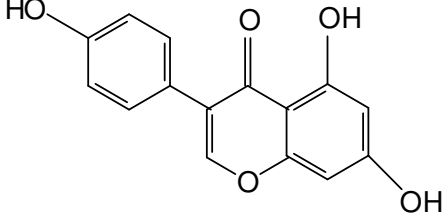
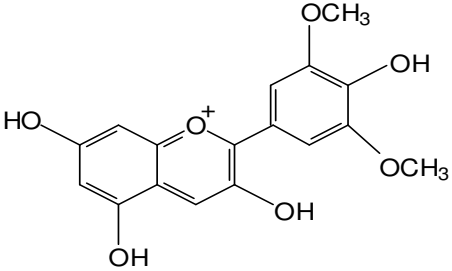
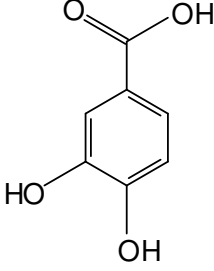
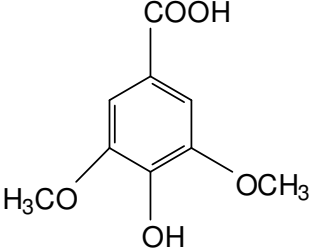
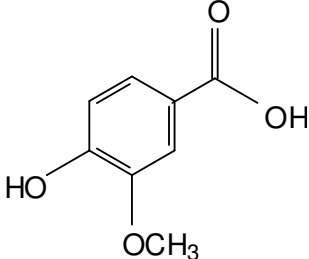
		anti-uroliathiatric against uric acid crystals ^[34]
	ethanolic and methanolic	diuretic ^[22, 35]
	butanolic	hemolytic ^[36]
	methanolic	hepatoprotective ^[37]
		larvicidal (α -amylase inhibitors) ^[38]
		proteinase inhibition ^[4, 39, 40]
	hydro-methanolic	nephrotoxicity management ^[41]
	phenols	ACE-1 inhibition (antidiabetic and antihypertensive activity) ^[42, 43]

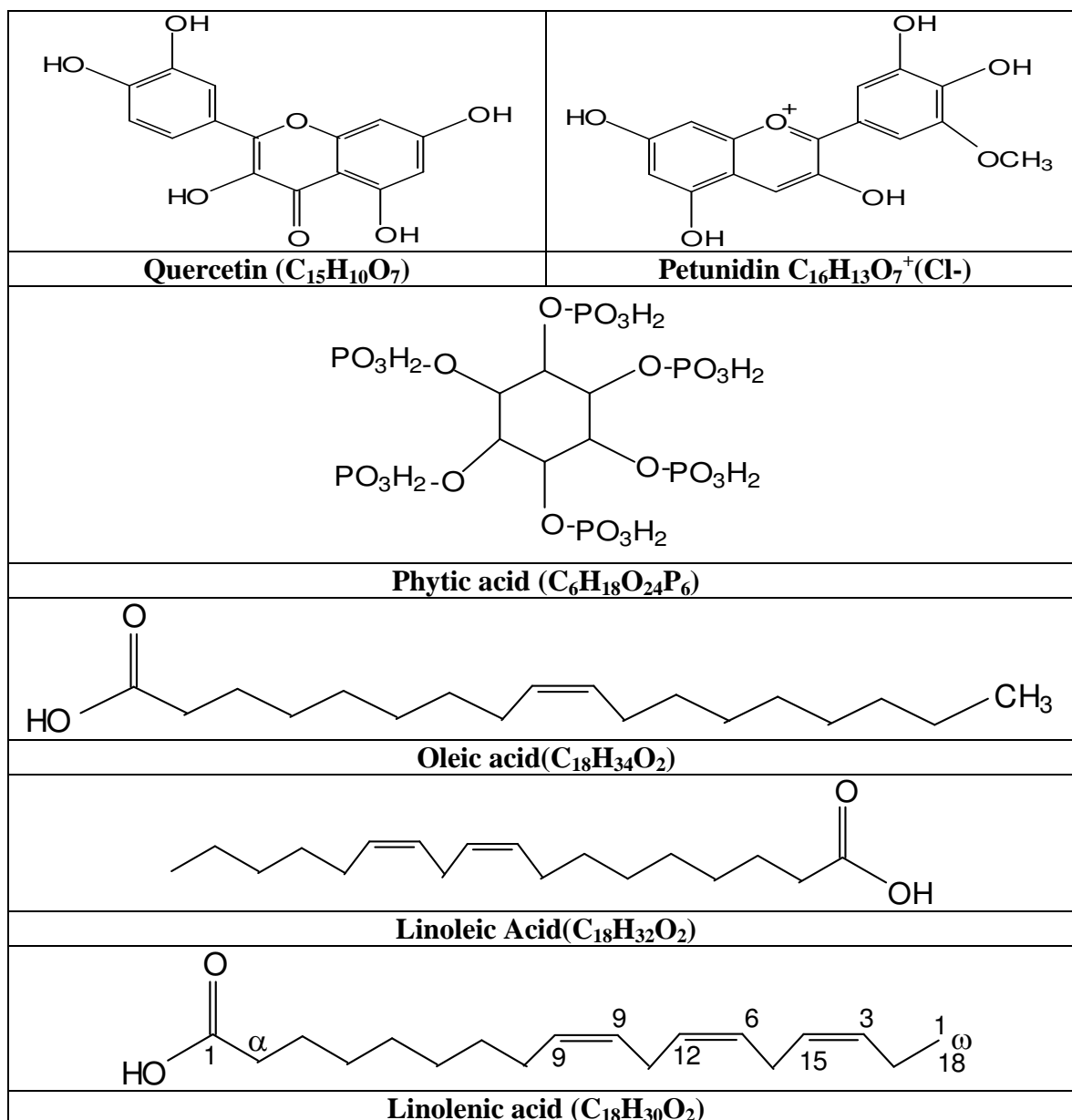
Table-6. Phytoconstituents of *Macrotyloma uniflorum*

Category	Phytoconstituents
Anthocyanins	cyanidin, delphinidin, malvidin, petunidin ^[44, 45]
Flavonoids	daidzein, genistein, kaempferol, myricetin, quercetin ^[44, 45]
Phenolic acids(benzoic acid derivatives)	gallic acid, protocatechuic acid, <i>p</i> -hydroxybenzoic acid, syringic acid, vanillic acid ^[44, 45]
Phenolic acids(cinnamic acid derivatives)	caffeic acid, chlorogenic acid, ferulic acid, <i>p</i> -coumaric acid, sinapic acid ^[44, 45]
Enzyme source	α - amylase ^[46]
	β -N-acetylglucosaminidase, α -and β glucosidase ^[47]
	urease ^[48]
Haemagglutinins	agglutinin and lectins ^[4]
Tannins	[4]
Phytic acid	[44, 49, 50]

Table-7. Chemical structures of the compounds isolated from *Macrotyloma uniflorum*.

	
Caffeic acid (C₉H₈O₄)	Chlorogenic acid (C₁₆H₁₈O₉)
	
Ferulic acid (C₁₀H₁₀O₄)	Cyanidin [C₁₆H₁₃O₇⁺(Cl⁻)]
	
Daidzein (C₁₅H₁₀O₄)	

	
Niacin (C₆H₅NO₂)	Delphinidin (C₁₅H₁₁ClO₇)
	
Para coumaric acid (C₉H₈O₃)	Sinapinic acid (C₁₁H₁₂O₅)
	
Kaempferol (C₁₅H₁₀O₆)	Myricetin (C₁₅H₁₀O₈)
	
Gallic acid (C₇H₆O₅)	Genistein (C₁₅H₁₀O₅)
	
Malvidin (C₁₇H₁₅O₇⁺)	Protocatechuic acid (C₇H₆O₄)
	
Syringic acid (C₉H₁₀O₅)	Vanillic acid (C₈H₈O₄)



CONCLUSION

The presented review describes the comprehensive, traditional medicinal uses, nutritional value, pharmacology and phytochemistry of *Macrotyloma uniflorum*. The data presented in this review could provide insights for future research aimed at both ethnopharmacological validation of the popular use of *Macrotyloma uniflorum* seeds and its exploration as a new source of bioactive molecules.

REFERENCES

1. Blumenthal, M, Staples, L. Origin, evaluation and use of *Macrotyloma* as forage - a review. *Tropical Grasslands*. 1993; 27: 16-29.
2. Nasir, E, Ali, S, I. Flora of Pakistan. Vol. 100 Papilionaceae. 1977; 1-389.

3. Feedipedia - Animal Feed Resources Information System. Horse gram (*Macrotyloma uniflorum*). 2010 [cited 2015 30th November]; Available from: <http://www.feedipedia.org/node/628>.
4. Bhartiya, A, Aditya, JKant, L.Nutritional and remedial potential of an underutilized food legume horsegram (*Macrotyloma uniflorum*): a review. JAPS, Journal of Animal and Plant Sciences.2015; 25(4): 908-920.
5. Verdcourt, B.Studies in the Leguminosae-Papilionoïdeae for the'Flora of Tropical East Africa': IV. Kew Bulletin.1970; 24(3): 507-569.
6. Alok, S, Jain, SK, Verma, AKumar, M.Pharmacognostic and phytochemical evaluation of *Dolichos biflorus* Linn. Asian Pacific Journal of Tropical Disease. 2014; 4: S97-S101.
7. Kirtikar, KRBasu, BD, Indian medicinal plants. 1976, India: Dehradun: International Book Distributors.
8. Ahmed S, Hasan MmMahmood Z A.Basic composition and caloric contents of *Macrotyloma uniflorum* (Lam.) Verdc., *Phaseolus lunatus* Linn., and *Phaseolus vulgaris* Linn., legume flours. PHARMANEST - An International Journal of Advances in Pharmaceutical Sciences. 2015; 6(5): 2984-2987.
9. Hiremath, J, Sharan, SVishwanath, K.Chemical Composition and Functional Properties of Some Important Genotypes of Horsegram (*Macrotyloma uniflorum* Lum Verdc). Karnataka Journal of Agricultural Sciences. 2001; 14(4): 943-946.
10. Ravindran, RSundar, SB.Nutritive value of horse gram (*Dolichos biflorus*) for egg-type chicks and growers. Tamilnadu Journal of Veterinary & Animal Sciences 2009; 5(4): 125-131.
11. Morris, JB, Wang, ML, Grusak, MATonnis, B.Fatty acid, flavonol, and mineral composition variability among seven *Macrotyloma uniflorum* (Lam.) Verdc. accessions. Agriculture. 2013; 3(1): 157-169.
12. Bolbhat, SDhumal, K.Mineral constituents in seeds of horsegram mutants. International Journal of Advanced Scientific and Technical Research. 2014; 4: 15-21.
13. Kadam, S, Salunkhe, DMaga, JA.Nutritional composition, processing, and utilization of horse gram and moth bean. Critical Reviews in Food Science & Nutrition. 1985; 22(1): 1-26.
14. Bravo, L, Siddhuraju, PSaura-Calixto, F.Composition of underexploited Indian pulses. Comparison with common legumes. Food Chemistry. 1999; 64(2): 185-192.
15. Sreerama, YN, Neelam, DA, Sashikala, VBPratape, VM.Distribution of nutrients and antinutrients in milled fractions of chickpea and horse gram: seed coat phenolics and their

- distinct modes of enzyme inhibition. *Journal of Agricultural and Food Chemistry*. 2010; 58(7): 4322-4330.
16. Kumar, DS, Prashanthi, G, Avasarala, H, Banji, D. Antihypercholesterolemic Effect of *Macrotyloma uniflorum* (Lam.) Verdc (Fabaceae) Extract on High-Fat Diet-Induced Hypercholesterolemia in Sprague-Dawley Rats. *Journal of Dietary Supplements*. 2013; 10(2): 116-128.
 17. Kawsar, S, Uddin, MS, Huq, E, Nahar, NY, Yasuhiro, O. Biological investigation of *Macrotyloma uniflorum* Linn. extracts against some pathogens. *Journal of Biological Sciences*. 2008; 8: 1051-1056.
 18. Sengupta, K, Mishra, AT, Rao, MK, Sarma, KV, Krishnaraju, AV, Trimurtulu, G. Efficacy of an herbal formulation LI10903F containing *Dolichos biflorus* and *Piper betle* extracts on weight management. *Lipids in Health and Disease*. 2012; 11(1): 176.
 19. Bharathi, V, Anand, V. Antiobesity effect of *Macrotyloma uniflorum* leaves extract on rats fed on hypercaloric diet. *World Journal of Pharmacy and Pharmaceutical Sciences*. 2014; 3(5): 1500-1504.
 20. Philip, A, Athul, P, Ajmal Charan, AT. Anthelmintic activity of seeds of *Macrotyloma uniflorum*. *HYGEIA*. 2009; 1(1): 26-27.
 21. Purwar, B, Saxena, Y. Effect of *Dolichos biflorus* on blood sugar and lipids in diabetic rats. *Indian Journal of Physiology and Pharmacology* 2013; 57(1): 63-71.
 22. Ahmad, M, Sharif, S, Mehjabeen, Sharif, H, Jahan, N, Naqvi, GR. Phytochemical and pharmacological studies on methanolic seeds' extract of *Dolichos biflorus*. *Pakistan Journal of Pharmaceutical Sciences*. 2014; 27(2): 335-341.
 23. Bigoniya, P, Bais, S, Sirohi, B. The effect of *Macrotyloma uniflorum* seed on bile lithogenicity against diet induced cholelithiasis on mice. *Ancient Science of Life*. 2014; 33(4): 242-251.
 24. Suralkar Aa, Kasture Sb. Evaluation of Antihistaminic activity of *Dolichos biflorus*. *International Journal of Pharma and Bio Sciences*. 2013; 4: 346-352.
 25. Panda, V, Suresh, S. Gastro-protective effects of the phenolic acids of *Macrotyloma uniflorum* (horse gram) on experimental gastric ulcer models in rats. *Food Bioscience*. 2015; 12: 34-46.
 26. Singh, R, Singh, M, Chandra, L, Bhat, D, Arora, M, Nailwal, T, et al. In vitro Antioxidant and free radical scavenging activity of *Macrotyloma uniflorum* (Gahat dal) from Kumauni region. *International Journal of Fundamental and Applied Sciences*. 2012; 1(1): 9-11.

27. Ravishankar, KPriya, P. In vitro antioxidant activity of ethanolic seed extracts of *Macrotyloma uniflorum* and *Cucumis melo* for therapeutic potential. *International Journal of Research in Pharmacy and Chemistry*. 2012; 2(2): 442-445.
28. Marimuthu, MKrisnamoorthi, K. In vitro antioxidant potential of chloroform seed extract of underutilized/less edible South Indian legumes. *PHARMANEST- An International Journal of Advances in Pharmaceutical Sciences*. 2013; 4(4): 647-658.
29. Das, I, Gupta, SK, Ansari, SA, Pandey, VNRastogi, RP. In vitro inhibition and dissolution of calcium oxalate by edible plant *Trianthema monogyna* and pulse *Macrotyloma uniflorum* extracts. *Journal of Crystal Growth*. 2005; 273(3-4): 546-554.
30. Chaitanya, DaK, Kumar, M, Reddy, A, Mukherjee, N, Sumanth, MRamesh, A. Anti urolithiatic activity of *Macrotyloma uniflorum* seed extract on ethylene glycol induced urolithiasis in albino rats. *Journal of Innovative trends in Pharmaceutical Sciences*. 2010; 1(5): 216-226.
31. Atodariya, U, Barad, R, Upadhyay, SUpadhyay, U. Anti-urolithiatic activity of *Dolichos biflorus* seeds. *Journal of Pharmacognosy and Phytochemistry*. 2013; 2: 209-213.
32. Bijarnia, R, Kaur, T, Singla, S, Tandon, C. A Novel Calcium Oxalate Crystal Growth Inhibitory Protein from the Seeds of *Dolichos biflorus* (L.). *The Protein Journal*. 2009; 28(3-4): 161-168.
33. Kieley, S, Dwivedi, RMonga, M. Ayurvedic medicine and renal calculi. *Journal of Endourology*. 2008; 22(8): 1613-1616.
34. Ahmad, J, Ejaz, A, Khalid, N, Tabassum, S. Inhibitory effects of aqueous extracts of natural products on the crystallization of urinary lithiasis [sic] in vitro. Part III ; Uric acid. *Pakistan Journal of Biochemistry*. 1992; 25: 65-70.
35. Ravishankar, KPriya, P. Evaluation of diuretic effect of ethanolic seed extracts of *Macrotyloma uniflorum* and *Cucumis melo* in rats. *International Journal of Pharma & Bio Sciences*. 2012; 3(3): 251-255.
36. Kawsar, SMA, Golam, M, Nahar, NHuq, E. Chemical constitutions and hemolytic activity of *Macrotyloma uniflorum* Linn. *International Journal of Natural and Engineering Sciences*. 2009; 3(1): 69-72.
37. Parmar, H, Das Sk.Kj., G. Hepatoprotective activity of *Macrotyloma uniflorum* seed extract on paracetamol and d-galactosamine induced liver toxicity in albino rats. *International Journal of Pharmacological Research*. 2012; 2(2): 86-91.
38. Gupta, L, Deshpande, S, Tare, VSabharwal, S. Larvicidal activity of the α -amylase inhibitor from the seeds of *Macrotyloma uniflorum* (Leguminosae) against *Aedes aegypti*

- (Diptera: Culicidae). International Journal of Tropical Insect Science.2011; 31(1-2): 69-74.
39. Ramasarma, PR, Rao, AARao, DR.Role of disulfide linkages in structure and activity of proteinase inhibitor from horsegram (*Dolichos biflorus*). Biochimica et Biophysica Acta (BBA)-Protein Structure and Molecular Enzymology.1995; 1248(1): 35-42.
 40. Sreerama, Y, Das, J, Rao, DGowda, L.Double-headed trypsin/chymotrypsin inhibitors from horse gram (*Dolichos biflorus*): purification, molecular and kinetic properties. Journal of Food Biochemistry.1997; 21(1): 461-477.
 41. Saha, SVerma, RJ.Efficacy Study of *Dolichos biflorus* in the Management of Nephrotoxicity. Asian Pacific Journal of Tropical Biomedicine.2012; 2(3): S1471-S1476.
 42. Wagner, H, Elbl, G, Lotter, HGuinea, M.Evaluation of natural products as inhibitors of angiotensin I-converting enzyme (ACE). Pharmaceutical and Pharmacological Letters.1991; 1: 15-18.
 43. Chen, C-H, Lin, J-Y, Lin, C-NHsu, S-Y.Inhibition of angiotensin-I-converting enzyme by tetrahydroxyxanthenes isolated from *Tripterospermum lanceolatum*. Journal of Natural Products.1992; 55(5): 691-695.
 44. Sreerama, YN, Sashikala, VBPratape, VM.Variability in the distribution of phenolic compounds in milled fractions of chickpea and horse gram: evaluation of their antioxidant properties. Journal of Agricultural and Food Chemistry. 2010; 58(14): 8322-8330.
 45. Kawsar, S, Huq, E, Nahar, NOzeki, Y.Identification and quantification of phenolic acids in *Macrotyloma uniflorum* by reversed phase HPLC. American Journal of Plant Physiology. 2008; 3(4): 165-172.
 46. Garg, MDobriyal, AK.Partial purification and characterisation of some low molecular weight α -amylases from *Dolichos biflorus*. Journal of Applied and Natural Science. 2011; 3(1): 75-77.
 47. Meyer, DBourrillon, R.Glycosidases of *Dolichos biflorus*. Isolation and general properties. Biochimie. 1972; 55(1): 5-10.
 48. Natarajan, K.Kinetic study of the enzyme urease from *Dolichos biflorus*. Journal of Chemical Education. 1995; 72(6): 556-557.
 49. Sreerama, Sasikala, VBPratape, VM.Nutritional implications and flour functionality of popped/expanded horse gram. Food Chemistry. 2008; 108(3): 891-899.
 50. Sreerama, YN, Sashikala, VB, Pratape, VMSingh, V.Nutrients and antinutrients in cowpea and horse gram flours in comparison to chickpea flour: Evaluation of their flour functionality. Food Chemistry. 2012; 131(2): 462-468.