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The pharmacology and medical importance of Dolichos lablab (Lablab purpureus)- A review

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Abstract:- The phytochemical analysis of *Dolichos lablab* showed that it contained sugar, alcohols, phenols, steroids, essential oils, alkaloids, tannins, flavonoids, saponins, coumarins, terpenoids, pigments, glycosides, anthnanoids, wide range of minerals and many other metabolites. The preliminary pharmacological studies revealed that *Dolichos lablab* possessed antidiabetic, antiinflammatory, analgesic, antioxidant, cytotoxic, hypolipidemic, antimicrobial, insecticidal, hepatoprotective, antilithiatic, antispasmodic effects and also used for the treatment of iron deficiency anemia. The current review discussed the chemical constituents and pharmacological activities of *Dolichos lablab.*

Keywords: *chemical, constituents, pharmacology, Dolichos lablab, Lablab purpureus*

I- Plant profile:

I. INTRODUCTION:

The World Health Organization (WHO) estimates that 4 billion people, 80 percent of the world population, presently use herbal medicine for some aspect of primary health care[1]. Plant showed wide range of pharmacological activities including antimicrobial, antioxidant, anticancer, hypolipidemic, cardiovascular, central nervous, respiratory, immunological, anti-inflammatory, analgesic antipyretic and many other pharmacological effects [2-50]. Phytochemical analysis of *Dolichos lablab* showed that it contained sugar, alcohols, phenols, steroids, essential oils, alkaloids, tannins, flavonoids, saponins, coumarins, terpenoids, pigments, glycosides, anthnanoids, wide range of minerals and many other metabolites. The preliminary pharmacological studies revealed that *Dolichos lablab* possessed antidiabetic, antiinflammatory, analgesic, antioxidant, cytotoxic, hypolipidemic, antimicrobial, insecticidal, hepatoprotective, antilithiatic, antispasmodic effects and also used for the treatment of iron deficiency anemia. This review will discuss the chemical constituents and pharmacological activities of *Dolichos lablab.*

Synonyms:

Lablab purpureus L. Sweet; *Dolichos lablab* L; *Dolichos purpureus* L; *Dolichos lablab* ssp ensiformis Thunb; *Dolichos cultratus* Thunb; *Dolichos bengalensis* Jacq; *Dolichos lablab* var; hortensis Schweinf & Muschler; *Dolichos albus* Lour; *Dolichos uniflorus*; *Dolichos lablab* ssp bengalensis Jacq; *Lablab niger* Medik; *Lablab vulgaris* Savi; *Lablab leucocarpos* Davi; *Lablab purpureus* ssp purpureus Verdc; *Lablab vulgaris* var; niger DC; *Lablab purpureus* ssp uncinatus Verdc; *Lablab perennans* DC; *Lablab nankinicus* Savi and *Lablab purpureus* ssp bengalensis (Jacq.) Verdc [51-53].

Taxonomic classification:

Kingdom: Plantae, **Subkingdom**: Viridiplantae, **Infrakingdom**: Streptophyta**Superdivision**: Embryophyta, **Division**: Tracheophyta, **Subdivision**: Spermatophytina, **Class**: Magnoliopsida, **Superorder**: Rosanae, **Order**: Fabales, **Family**: Fabaceae, **Genus**: *Lablab*, **Species**: *Lablab purpureus* (*Dolichos lablab*)[51].

Common names:

Arabic: Lablâb, Lablab, Lubiah; **Bengali**: Rajashimbi; **Burmese**: Pe-Gyi; **Chinese**: Bian dou, Huo lian bian dou, Peng pi dou, Teng dou, Yan li dou, Que dou; **English:** Dolichos bean, Hyacinth bean, Bonavist bean, Seim bean, Lablab bean, Egyptian kidney bean, Indian bean, Common bean, Field bean, Pendal bean, Pole bean, Waby bean; **French**: Dolique D´egypte, Pois Nourrice; **German**: ågyptische Fasel, Faselbohne, Gemeine Lablab, Helmbohne; **Hindi**: Sem; **Italian**: Dolico Egiziano, Fagiolo D´egitto, Fagiolo Del Cairo, Fagiolo Egiziano; **Japanese**: Fiji Mame, Fuji Mame, Ingen; **Nepalese**: Raaj Simii, Simii; **Pprtuguese**: Dólico Do Egipto, Feijão Cutelinho; **Russian**: Lobija; **Spanish**: dolique lab-lab, dolique d'Egypte, frijol jacinto, quiquaqua, caroata chwata, poroto de Egipto, chicarros, frijol caballo, gallinita, frijol de adorno, carmelita, frijol caballero, pois nourrice; **Turkish**: Lablab; **Vietnamese**: Dâu van [51-53].

Distribution:

The wild forms of lablab are believed to have originated in India or South-East Asia, and it introduced into Africa from southeast Asia during the eighth century. It was widely distributed to many tropical and subtropical countries [54]. Now it was found in Malaysia, Indonesia, Philippines, Mainland China, Iraq, Kenya, Tanzania, Uganda, Chad, Ethiopia, Sudan, Angola, Malawi, Mozambique, Zambia, Zimbabwe, Botswana, Namibia, South Africa, Cote, D'Ivoire, Ghana, Niger, Nigeria, Senegal, Sierra Leone, Togo, Cameroon, Gabon, Rwanda, Madagascar, the Caribbean, Central and South America [51, 55].

Description:

Dolichos lablab is a woody climbing herb which can reach a length of 5 m. Leaves are pinnate and generally 3-foliolate. Leaflets are acute, entire, 6–12 cm by 5–9 cm. Flowers are white or purplish pink. Fruits are green pods, 6 cm long by 2 cm wide, flattened, contain 4–5 seeds and turn light brown when mature [56-59].

Traditional uses:

The plant was used as decoction in alcoholic intoxication, for the treatment of cholera, diarrhoea, globefish poisoning, gonorrhoea, leucorrhoea and nausea. Seeds were used to stimulate stomach , as antidote for poisoning, for menopause and spasms, and for the treatment of cholera, diarrhoea, colic, rheumatism and sunstroke. The juice from the fruit pods was used as astringent, digestive, stomachic, to expel worms and for the treatment of inflamed ears and throats. The flowers were used to treat inflammation of uterus and to increase menstrual flow [56, 60-61]. The plant was also used as anti-inflammatory, aphrodisiac, antispasmodic, antidiabetic**,** febrifuge and for flatulent, bilious, stomachic and phlegmatic disorders [62]. In Africa, Asia, and the Caribbean. It was also consumed as a green vegetable (green bean, pod, leaf) [63-64].

II. CHEMICAL CONSTITUENTS:

Phytochemical analysis showed that the fresh leaf extracts of *Dolichos lablab* contained sugar, alcohols, phenols, steroids, essential oils, alkaloids, tannins, flavonoids, saponins, coumarins, terpenoids , pigments, glycosides and anthnanoids [65-67].Phytochemicals study of the raw and aqueous crude extracts of the three varieties (Rongai brown, Rongai white and Highworth black) of *Lablab purpureus* seeds showed that the seeds contained trypsin inhibitor contents, Heamagglutinin content, cyanogenic glycosides, oxalates, phytates, tannins and saponins [68]. Nutritional analysis revealed that the dry seed contained 33% starch as the major component, protein 25%, a very low fat content 0.8% and high dietary fibre 7.2%. It also contained oligosaccharides included raffinose and stachyose 3.5%, phytic acid 82.0 mg/g, phosphorus 430mg/g and phytates phosphorus 243 mg/g. The leaves were rich in protein (up to 28 percent), legumes, and iron 155 mg, zinc 30 mg per 100 g of leaves, dry weight. The grain had zinc of 34mg/kg and iron of 57mg/kg [69-70].However, the mature seeds of five cultivars of dolichos bean (*Dolichos lablab*.) were analysed for some nutritional factors. The cultivars showed considerable variation in their composition. On a dry matter basis, the percentage of crude protein varied from 22.4 to 31.3, crude fiber, 7.62 to 9.63 and total carbohydrate, 54.2 to 63.3. The amounts of calcium, phosphorus, phytate phosphorus and iron ranged from 36.0 to 53.5, 388 to 483, 282 to 380 and 5.95 to 6.90 mg/100 g respectively [71].

Chemical analysis of the seeds of *Lablab purpureus* grown in Al-Gassim region of Saudi Arabia showed that the seeds contained substantial amounts of potassium and low contents of calcium, iron and zinc. Amino-acid composition revealed high contents of glutamic and aspartic acid, leucine and lysines. Fatty acid profiles showed that the oils composed of 24.2% saturated fatty acid, 18.42% monounsaturated fatty acid and 57.38% polyunsaturated fatty acid, and linoleic acid (44%) was the major constituents of fatty acid [72]. Arcelin and dolichin proteins were purified from the seeds of bean *Dolichos lablab* [73-74]. The proximate and mineral compositions, vitamins (niacin and ascorbic acid), seed protein fractions, amino acid profiles, fatty acids, *in vitro* protein digestibility and anti-nutritional factors of five varieties of *Lablab purpureus* were analysed. The plant varieties contained crude protein ranged from 20.46-25.47%, crude lipid 2.69-4.17%, total dietary fiber 4.98-6.90%, ash 3.97-4.48% and carbohydrates 60.63-66.32%. The energy level of the seed (1524.20-1604.34kJ/100DM). The in vitro protein digestibility of the legumes ranged from 64.36-70.30%. The seeds were found to be rich source of minerals and vitamins, sodium 87.00 ± 0.12 -129.38 ± 0.05, potassium 1653.07 ± 1.52-1768.95 ± 1.06, calcium 363.67 ± 1.98-575.03 ± 2.49, magnesium 156.00 ± 0.96-391.50 ± 1.74, phosphorus 500.27 ± 2.25- 733.00 ± 5.68, iron 6.55 ± 0.03-10.33 ± 0.09, manganese 4.88 ± 0.02-7.09 ± 0.05, niacin 16.32 ± 0.14-21.36 ± 0.21, ascorbic acid 25.06 ± 0.07- 39.06 ± 0.17 mg 100/ g seed flour. Analysis of seed protein revealed that the globulins constituted the major bulk of the seed protein. Profiles of amino acids of total seed protein revealed that they contained relatively higher levels of all essential amino acids except tryptophan and sulphur containing amino acids. The seed lipids contained large proportion of unsaturated fatty acids. The total free phenolics was 0.21-0.32g/100g , tannin 0.23-0.40 g/100g, L-DOPA 0.21-0.49 g/100g, phytic acid 314-421mg/100g, hydrogen cyanide 0.22-0.33mg/100g, trypsin inhibitor activity 24.30-34.56 TIU/ mg protein. Stachyose was the principle

oligosaccharide of all the varieties of *Lablab purpureus* [75]. The effects of dry heated and pressure cooking of *Dolichos lablab* bean, on total phenolic components were investigated. The raw and processed samples were extracted with 70% methanol. Processing of legumes caused decreases in total phenolic content when compared to the raw samples. However, the dry heating caused remarkable increase in tannin contents (1.809 ± 0.25 g GAE/100 g extract) [76].Mono- and oligosaccharides (7.3%) were extracted from *Dolichos lablab* endosperm. They were identified as fructose, galactose, glucose, sucrose, raffinose, tachyose, and verbascose [77].

From the glycoside mixture of the seeds of *Dolichos lablab*, 6 new oleanane type triterpene bisdesmosides were isolated together with chikusetsu saponin IV. The structures of Lablabosides A, B and C were determined on the basis of chemical and physicochemical evidence as 3-0-(alpha-L-rhamnopyranosyl (1→2)-beta D-galactopyranosyl (1→2)-beta-D-glucopyranosiduronic acid)-28-0- (beta D-glucopyranasyl oleonic acid; 3 - 0 (alpha - L. rhamnopyranosyl (1→2) (1→2) - beta - D-glucopyranosiduromic acid)-28-0- (beta-D-glucopyranosyl) 24-epi-hederagenin, and 3-0-(alpha-L-rhamnopyranosyl (1→2)-beta-D- gala etopyranosyl (1→2) beta - glucopyranosiduronic acid) - D- 28-0-(alpha-L-rhamnopyranosyl (1→2)-beta-D-glucopyranosyl) 24-epi-hederagenin [78].Two lectins were isolated from the seeds of *Dolichos lablab* var. lignosus (field bean) and *Dolichos lablab* var. typicus (Lablab bean). Both lectins were glycoproteins with a molecular weight of 60,000 and seemed to be made up of 4 similar subunits (apparent molecular weight 15,000). The carbohydrate content of the lectins was mostly fucose (2-5 mol per mol of protein), mannose (5-8 mol per mol of protein) and N-acetyl glucosamine (1-2 mol per mol of protein). The amino acid composition of both lectins was similar. Both lectins caracterised by similar tryptic peptide map. Alanine and serine were the only N and C-terminal amino acids for both lectins. The lectins were found to contain low amounts of bound metals such as manganese, magnesium and calcium. The near ultra-violet circular dichroism spectra of the lectins were similar to that of sainfoin. Circular dichroism data indicate that tyrosine and tryptophan residues were involved in sugar binding [79].A total of 262 volatile compounds were identified in *Lablab purpureus*. The volatile constituents were dominated by volatile terpenes and terpenoids, and their derivatives, which accounted for 46% of all the detected compounds. The detected compounds were separated into 12 classes namely; alcohols (28), aldehydes (10), ketones (19), esters (46), acids (7), oxygen heterocycles (1), pyrazines (5), thiazoles (4), hydrocarbons (57), terpenes and terpenoids (59), phenols (5) and miscellaneous compounds. The most common individual compounds were Isopentyl alcohol, 3,7,11- Trimethylhentriacontane, (E)-2-Octene, 7,11,17,21-Tetramethylhentriacontane/ 7,11,17,25- Tetramethylhentriacontane, 6-Methyldotriacontane, Norbornene, Pentanol, 4-methyl thiazole, 5,9,13-Trimethylnonacosane/5,9,15-Trimethylnonacosane/5,9,19-Trimethylnonacosane, 3,7,11,15-Tetramethylhentriacontane, Methyl Butyrate, Isopentyl formate, 13,17-Dimethyl nonacosane, 13-Methylhentriacontane, 9-Methylhentriacontane, 7- Methyl hentriacontane, Santene, Heptanal/n-Nonane, 5-Methylnonacosane, 5- Methyl hentriacontane, 3,11,19-Trimethylhentriacontane and 3,7-Dimethyl hentriacontane [80].Flavonoids isolated from the flower of *Dolichos lablab*, these compounds were identified as luteolin, cosmosiin, luteolin-4′-*O*-β-D-glucopyranoside and luteolin-7-0-beta-D-glucopyranoside [81].

Various plant parts of Lablab purpureu were analysed for rotenoid content. The maximum content was recorded in the roots and the minimum in the seeds. Six rotenoids (deguelin, dehydrodeguelin, rotenol, rotenone, tephrosin, and sumatrol) were isolated from different parts of the plant [32].

III. PHARMACOLOGICAL EFFECT:

Antidiabetic effect:

The antidiabetic activity of methanolic extract of *Dolichos lablab* (MEDL) seeds was studied in streptozotocin-nicotinamide induced diabetic rats. The methanolic extract of the seeds of *Dolichos lablab* was given by oral route at doses of 200 and 400mg/kg bw. MEDL dose dependely ($P< 0.001$) reduced blood glucose levels, total cholesterol, triglycerides, SGPT, SGOT levels compared to untreated diabetic rats. MEDL 400 mg/k bw possessed more promising antidiabetic activity compared to 200mg/kg bw [61, 67].The antidiabetic effect of ethanolic extract of *Dolichos lablab* leaves and seeds was investigated in alloxan induced diabetic rat. Alcoholic extracts of dried leaves of *Dolichos lablab* was given orally for 7 days. The oral administration of extracts at doses of 200 mg/ kg lead to a significant blood glucose reduction [83]. The antihyperglycemic properties of methanol extract of beans (fruits containing seeds) of *Lablab purpureus* was investigated using oral glucose tolerance test. Administration of methanol extract of beans led to dose-dependent and significant reductions in blood glucose levels in glucose-loaded mice. At doses of 50, 100, 200 and 400 mg per kg body weight, the extract reduced blood glucose levels by 16.4, 39.1, 40.1, and 54.8%, respectively compared to control animals [84].

In the Treatment of Iron deficiency anemia:

The effectiveness of *Dolichos lablab* beans extract in iron deficiency was investigated in rats. Anemia was induced by tail clipping procedure until the level of hemoglobin and hematocrit became below normal. The activity of aqueous extract of the beans of *Dolichos lablab* at the dose of 100 mg / kg body weight orally for 14

days, was investigated by monitoring the change in hemoglobin and hematocrit levels of rats after 14 days of treatment. Results of the study showed a significant increase in hemoglobin level in experimental group from 11.33 to 14.33, while hematocrit level was increased from 34.00 to 43.00 [85].

Antiinflammatory and analgesic effects:

The anti-inflammatory effect of methanol extracts of two Bangladeshi bean pods *Lablab purpureus* sweet white and purple was studied using protease inhibition. *In vitro* anti-inflammatory investigation showed that there was a linear relation of % inhibition for the white bean pods which indicated positive anti-inflammatory property [86].Mannose-specific legume lectin isolated from the seeds of *Dolichos lablab* (FRIL) evoked dose-dependent paw edema and increasing animal paw volumes. The edematogenic effect of FRIL was paralleled by an increase in vascular permeability, about 10-fold higher compared to control. FRIL also significantly raised the animals flinch reaction in the first, third and fifth hours in response to mechanical stimulation. The anti-inflammatory effect elicited by FRIL was partly inhibited by α-d-methyl mannoside. The histopathological analysis of animal paws showed a characteristically acute inflammatory process that included severe infiltration of mixed leukocytes, changes in cytoarchitecture, edema and focal areas of hemorrhage. In addition, in silico assays confirmed that FRIL preferentially interacted with trimannoside that makes up the core N-glycans cell [87]. The antinociceptive properties of methanol extract of beans (fruits containing seeds) of *Lablab purpureus* was observed by cecking abdominal constrictions in intraperitoneally administered acetic acid-induced pain model in mice. The methanolic extract reduced the number of abdominal constrictions by 32.3, 45.2, 54.8, and 58.1, respectively at four doses. A standard pain relieving (antinociceptive) drug, aspirin, reduced the number of writhings by 48.4 and 61.3%, respectively, when administered at doses of 200 and 400 mg per kg body weight [84].

Antioxidant effect:

The antioxidant effect of methanol extracts of two Bangladeshi bean pods *Lablab purpureus* sweet white and purple was studied using DPPH free radical scavenging method. In DPPH test the lowest and highest IC_{50} values were 430.00µg/ml and 853.13µg/ml, with *Lablab purpureus* sweet purple and *Lablab purpureus* sweet white respectively. The total flavonoid contents of the test samples were 42.55±5.77 and 32.09±0.36 mg/g quercetin equivalents for white and purple respectively [86]. The effects of dry heated and pressure cooking of *Dolichos lablab* bean, on total phenolic components were investigated. The raw and processed samples were extracted with 70% methanol. Processing of legumes caused decreases in total phenolic content when compared to the raw samples. However, the dry heating caused remarkable increase in tannin contents (1.809 ± 0.25 g GAE/100 g extract) [76].

Cytotoxic effect:

The cytotoxic effect of methanol extracts of two Bangladeshi bean pods *Lablab purpureus* sweet white and purple was studied using brine shrimp lethality test. In Cytotoxicity test LC_{50} value was 960.06 µg/ml for *Lablab purpureus* sweet purple and 66.5 µg/ml for *Lablab purpureus* sweet white, so *Lablab purpureus* sweet white was more potent [86].The cytotoxic activity of crude extracts (chloroform, n-hexane, ethyl acetate) of leaves of *Lablab purpureus* were studied using Brine Shrimp Lethality Bioassay and compare with LC_{50} values of standard Vincristin sulphate as a positive control. The results revealed significant cytotoxicity against *A. salina,* with LC_{50} 13.88µg/ml, 19.17µg/ml and 17.97µg/ml for n-hexane, chloroform and ethyl acetate extracts respectively [88].

Hypolipidemic effect:

The hypocholesterolemic effect of germinated Indian bean (*Dolichos lablab* L. var lignosus) was studied in hypercholesterolemic rats. Supplementation of the diet with dried powder of soaked bean almost brought the plasma cholesterol from 178 ± 1.85 to 72.5 ± 0.75mg/dl compared with that of the control (61.5 ± 0.70), although the liver cholesterol was still three times higher compared with the control. The authors concluded that the 24h germinated Indian bean cotyledons could effectively counteract the effects of added cholesterol on liver and plasma by their high fiber content coupled with enormous increase in ascorbic acid levels [89].

Antimicrobial effect:

The antibacterial activity of leaf and flower extracts of *Lablab purpureus* was studied against clinical *Staphylococcus aureus* isolates. Both extracts showed antibacterial activity, but the flower extract showed marked inhibition of *Staphylococcus aureus* isolates [90]. The antimicrobial activity of crude extracts (chloroform, n-hexane, ethyl acetate) of leaves of *Lablab purpureus* L. were studied using disc diffusion technique. Extracts were tested against eleven important pathogenic bacteria including both Gram positive and Gram negative bacteria and three fungi. The tested bacteria were *B. megaterium, B. subtilis, Staphylococcus aureus, Sarcina lutea, Escherichia coli, Salmonella paratyphi, S. typhi, Shigella boydii, S. dysenteriae, Vibrio mimicus* and *V. parahemolyticus*. The

extracts showed antimicrobial activity against most of the bacterial strains with an average zone of inhibition of 8-20mm. The tested fungi were *Saccharromyces cerevaceae*, *Candida albicans* and *Aspergillus niger*. The extracts showed moderate to good antifungal activity with an average 9 -15 mm zone of inhibition. Among the three solvent extracts used, the most effective extract was n-hexane extract and maximum activity (20 mm, zone of inhibition) was recorded against *Staphylococcus aureus* with minimum inhibitory concentration (MIC) values of 64µg/ml. The maximum zone of inhibition for chloroform extract was 17mm against *Bacillus subtilis* and *E.coli* with MIC of 128µg/ml and 32µg/ml respectively. The maximum zone of inhibition for ethyl acetate extract was 17mm against *Vibrio mimicus* with MIC values of 64µg/ml [88].A protein, dolichin isolated from *Dolichos lablab*, exhibited antifungal activity against Fusarium oxysporum, Rhizoctonia solani, and Coprinus comatus [73]. A 36-kDa alpha-amylase inhibitor was isolated from *Lablab purpureus*. It inhibited the alpha-amylases from several fungi but had little effect on those from animal and plant sources. The protein inhibited conidial germination and hyphal growth of A. flavus. It also agglutinated papain-treated red blood cells from human and rabbit [91]. Dolichin, was also capable of inhibiting human immunodeficiency virus (HIV) reverse transcriptase and alpha- and beta-glucosidases which were glycohydrolases implicated in HIV infection. It had very low ribonuclease and cell-free translation-inhibitory activities [73].

Insecticidal effect:

Arcelins, the protein isolated from seed flour of the Indian wild bean, *Lablab purpureus* showed insecticidal activity against Callosobruchus maculates [74], *Lablab purpureus* proteins at 2% in the diet resulted in retarded *Rhyzopertha dominica* and *Oryzaephilus surinamensis* development. However, 5% dose of the *Lablab purpureus* fraction resulted in complete mortality of all larvae of *Rhyzopertha dominica* and *Oryzaephilus surinamensis* [92].

Hepatoprotective effect:

The hepatoprotective effects and underlying mechanism of *Dolichos lablab* water extract (DLL-Ex) were assessed using an *in vitro* cellular model in which nonalcoholic fatty liver disease (NAFLD) was simulated by inducing excessive FFA influx into hepatocytes. HepG2 cells were treated with DLL-Ex and FFAs for 24 h. DLL-Ex inhibited expression of CD36 in HepG2 cells, which regulates fatty acid uptake, as well as BODIPY-labeled fatty acid uptake. Additionally, DLL-Ex significantly attenuated FFA-mediated cellular energy depletion and mitochondrial membrane depolarization. Furthermore, DLL-Ex enhanced phosphorylation of AMPK, indicating that AMPK was a critical regulator of DLL-Ex-mediated inhibition of hepatic lipid accumulation, possibly through its antioxidative effect [93].

Other effects:

Antilithiatic study revealed that the methanolic extract of white and black seeds of *Dolichos lablab* possessed antilithiatic activity, but less than that recorded for the extract of leaves and bulbs of *Nymphaea odorata* [65]. Sixty seven percent inhibition of spasm in smooth muscles were possessed by *Dolichos lablab* alcoholic fraction at 100 mg/kg body weight [94].Three kinds of serine protease inhibitors were purified from *Dolichos lablab* seeds and named Dolichos protease inhibitor 1, 2 and 3 (DI-1, DI-2 and DI-3), respectively. The inhibition constant (Ki) for these inhibitors was measured against several known serine proteases. All three Dolichos protease inhibitors (DI-1, DI-2 and DI-3) inhibited the activity of trypsin and plasmin, but had no effect on thrombin and kallikrein (either for human plasma kallikrein or for porcine pancreas kallikrein). DI-1 inhibited chymotrypsin most effectively ($Ki = 3.6\text{-}10^{-9}$ M), while DI-2 displayed inhibitory activity for porcine pancreatic elastase ($Ki = 6.2\text{-}10^{-8}$ M). Pre-treatment with 33 mg/kg of DI-mixture (active fractions from C18 open column chromatography that included DI-1, DI-2 and DI-3) inhibited the induction of pseudomonal elastase-induced septic hypotension and prevented an increase in bradykinin generation in pseudomonal elastase-treated guinea pig plasma. Also, the increase of kallikrein activity, by injection of pseudomonal elastase, was inhibited by the pretreatment of the DI-mixture in a guinea pig. Since the DI-mixture had no inhibitory effect on kallikrein activity when Z-Phe-Arg-MCA was used as a substrate. *In vitro* study showed that its inhibitory activity in the pseudomonal elastase-induced septic hypotension model might not be due to a direct inhibition of plasma kallikrein in the activation cascade of the Hageman factor and prekallikrein system [95].

Side effects and contraindications:

Acute and chronic toxicity studies were carried out using mice. In acute toxicity studies, a dose of 250 mg/kg of dried extract were orally administered to mice, then, they were observed for motor reflexes for 48 h. No mortality was observed and the behavioral pattern and motor reflex were unaffected. In chronic toxicity studies, mice were divided into two groups, in the test group, a dose of dried extract of *Dolichos lablab* leaves of 250 mg/kg was administered daily to mice for a period of 15 days. The body weights were recorded at an interval of 5 days. No mortality or biochemical changes were recorded in the chronic toxicity study [83].Extraction of the beans

with 80% ethanol did not however alter the trypsin inhibitor or haemagglutinin activities. The protein isolate and acid-extracted residue which had low trypsin inhibitor and haemagglutinin activities, did not also promote growth. Thus, the antigrowth and toxic effects of the green bean were not due to only trypsin inhibitor and haemagglutinin and heat treatment of both dry and green beans was essential for promoting growth in rats. However, even after heat treatment, the nutritional value of the protein was lower than that of casein presumably on account of amino acid deficiencies [96].The plant beans should not be taken internally uncooked. Uncooked hyacinth bean can cause abdominal problems and was considered toxic. The herb was avoided in people suffering from cold, flu or chills. While boiling or cooking the herbal pods, the water should be changed as many times as possible. Dry seeds of hyacinth bean have high amounts of cyanogenic glucosides and therefore they were considered toxic [97].

IV. CONCLUSION

The current review discussed the chemical constituents and pharmacological effects of *Dolichos lablab* as promising medicinal plant with wide range of pharmacological activities which could be utilized in several medical applications.

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