A BRIEF RESUME OF THE GENUS, DOLICHOS

Utpal Bhattacharrya¹, Sadhana Khawas², Pijush Kundu¹, Bidyut Basak¹ and Subrata Laskar¹*

¹Department of Chemistry, The University of Burdwan, Burdwan, W. Bengal, India.
²Department of Chemistry, Sidhu Kanhu Birsha University, Purulia, W. Bengal, India.

ABSTRACT

A compilation of the different chemical constituents isolated from the seeds of the different plants of the genus Dolichos, which consists of about 100 species, are presented (till 1998 in chemical abstracts and published papers related to these genera) in this resume. The botanical classification, traditional uses and chemical constituents isolated from some species of this genus with their activities have been discussed. This genus is characterised by various class of compounds, viz. sterols, terpenes, growth regulation, cytokines, fatty acids, saponine, jiberellins, lectins, amino acids, proteins, etc. In the present review an attempt has been made to explore different aspects of Dolichos.

INTRODUCTION

Among the plants often used in traditional medicine, Dolichos species which belong to the most populated legume families in the plant Kingdom is Fabaceae. The plant Kingdom constitutes 630 genera and over 18,000 species.¹ The members of the family are usually herbs and shrubs or trees, often climbing.¹ They have woody rhizomes. The leaves have single blades or pinnate, divided into three leaflets. The plants sometimes produce their leaves after flowering.² Their flowers are regular or irregular, slightly perigynous and white or purple or occasionally yellow in colour. The fruits are flattened legume pod and seeds are exalbuminous; embryo large; cotyledors are fleshy or leafy.¹ Though the most important genus in this family Dolichos consists species about 100 in the world but only five to seven species are known in India.³ Among these species Dolichos biflorus Linn* (Horsegaram or Kulthi) is well known throughout India as a draught resistant crop. It also enriches the soil with nitrogen. So after harvesting the seeds, the soil can be ploughed with green manure.⁴
Among all the Indian Pulses, Kulthi strikes the nadir of price list in this era of escalating price hike and, as a result, it is used as cattle feed all over the country. The other important species are *Dolichos falcatus* Klein, *Dolichos lablab* Linn, *Dolichos trilobatus* Linn and *Dolichos soja* Linn. Different species have different common or local name, such as *Dolichos biflorus* is known as Horesgram and others are Kurtikalai in Bengali, Kulattha in Sanskrit, Kuthi in Hindi and Marathi, Kollu in Tamil. *Dolichos falcatus* is known as Kattamara in Tamil. *Dolichos lablab* is known as Indian butter bean in English, Makhansem in Bengali, Madhusarkara in Sanskrit, Sem in hindi, Avarai in Tamil, Pavta in Marathi, Val in gujrati, Chikkudu in Telegu, and Chapparada avare in Karnataka. *Dolichos trilobatus* is commonly known as Mugani in Bengali, Mudgaparni in Sanskrit, Rakhalalai in Hindi, Panipayer in Tamil and Pillipesara in Telegu. *Dolichos soja* is known as Soyabean in English, Garikalai in Bengali, Bhat in Hindi and Patnijokra in Assam. The plants of *Dolichos* genus are rich source of sterol, sterol derivatives, terpenoids, cytokinins, saponins, flavones, lectins, and other different type of compounds. So, a brief account on the occurrences, folk medicinal properties, chemical constituent and their activities of *Dolichos* species available in India may be helpful in appraising the importance of this group of plants.

**Botanical Classification**

The genus *Dolichos* comprises nearly 100 species but only 5-7 species are known in India. The scientific classification of this genus is as follows.

Kingdom: Plantae
Order: Fabales
Family: Fabaceae
Sub-family: Faboideae
Tribe: Phaseoleae
Genus: *Dolichos* L.

**Occurance and Distribution**

*Dolichos biflorus* is a native of India and is distributed throughout the tropical regions. It occurs widely in different parts of India even in Himalayas and is an important crop plant in Maharashtra, Karnataka, Tamilnadu and Andhra Pradesh, Chota Nagpur and many parts of Assam. It is also found in Sri Lanka, ascending to 3000 ft in Sikkim. *Dolichos falcatus* is found in Himalayas, from Kumaon to Khasia, ascending to 7500 ft and also in plane of Western peninsula. *Dolichos lablab* is usually wild and universally cultivated throughout
India, ascending in the Himalayas to 6,000 –7,000 ft. *Dolichos trilobatus* is wild or cultivated throughout India, ascending up to an elevation of 2,1000 m in the North-east. *Dolichos soja* is cultivated as a pulse – crop mainly in Kashmir, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Maharastra, Gujrat, Manipur and Nagahills.\[5, 6, 7\]

**Traditional application as Medicine**

Almost all the *Dolichos* plants have been used for the treatment of various ailments. Seeds of *Dolichos biflorus* are used as astringent, diuretic and tonic; used in powder form as antidiaphoretic. They are useful in haemorrhoids, tumours, bronchitis, heart diseases, colic, worms, fever, urticaria and rheumatoid arthritis. Decoction of seeds is used in leucorrhoea and menstrual disorders, and in combination with milk acts as anthelmintic. Soup prepared from pulses is an useful diet in subacute cases of enlarged liver and spleen. Roots of *Dolichos falcatus* are used in piles, constipation, ophthalmia and skin diseases. Decoction of seeds are given in rheumatism. Seeds of *Dolichos lablab* are febrifuge, stomachic, antiseptic and aphrodisiac. Pods are beneficial in nasal haemorrhage. Roots are poisonous. Whole plant of *Dolichos trilobatus* is used as fabrifuge. Leaves are sedative, used in cataplasm for weak eyes. Decoction of leaves is used in intermittent fever. Soyamilk isolated from *Dolichos soja* is of particular value in case of milk-allergy and in special diet. Soyabeen seed oil and soyabean meal are prescribed in cases of hypoproteinemia and malnutrition. Decoction of bark is used as astringent.\[5, 6, 7\]

**Chemical constituents and biological activity**

It is well known that plant synthesize and store various types of chemical compounds e.g. proteins, oils, fats, alkaloids, steroids, terpenes, growth regulators, carbohydrates etc. in their seeds as food materials for the germination, development and protection of fresh plants. Now-a-days these proteins, carbohydrates, oils and fats extracted from seed materials are well utilised elsewhere everyday. Common examples are sesame, mustard, peanut (itself as a food material), soyabean etc. But there are quite a number of seeds which are still now explored for the above purposes and it is also true for *Dolichos* seeds, although a number of investigations have been carried out on the chemical constituents of its different species in various laboratories of different parts of world. It may be mentioned here that only lectins isolated from the seeds of *Dolichos biflorus* have been utilised so far (discussed in later). Available literature indicates\[8\] Kulthi seeds contain 11.8% moisture, 22% crude protein,
0.5% fat, 3.1% mineral matter, 5.3% fibre, 57.3% carbohydrates and trace amount of iron, Phosphorus and Calcium.

A brief review on the chemical investigation done so far on the seeds of different available species of Dolichos in India is given below. It is well known fact that plant kingdom is a rich source of sterols. Dolichos is not an exception. A number of sterols were isolated in the past few years from the seeds of D.bilorus, D.bulbosus and D.labl. However, of these three species, Dolichos biflorus draws special attention because of its high sterol content. It is noteworthy that presence of mostly Δ^5 sterols was reported. Recently, a few numbers of Δ^7 and Δ^9 sterols were also isolated. A table of Δ^5 sterols along with source, melting point and molecular formula was depicted as hereunder. The basic skeleton of Δ^5 sterols is as follows:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Compound</th>
<th>Source</th>
<th>Molecular formula</th>
<th>Melting point</th>
<th>Nature of substituents (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cholesterol[9]</td>
<td>D. biflorus (Seed)</td>
<td>C_{22}H_{46}O</td>
<td>118-20\degree</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M.wt. 386</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>24-α-methylcholest-5-en-3-β-ol[9]</td>
<td>Do</td>
<td>C_{28}H_{48}O</td>
<td>140-43\degree</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M.wt. 400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>24-β-methylcholest-5-en-3-β-ol[9]</td>
<td>Do</td>
<td>C_{28}H_{48}O</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M.wt. 400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>24-α-ethylcholest-5-en-3-β-ol[9]</td>
<td>Do</td>
<td>C_{29}H_{50}O</td>
<td>121-23\degree</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M.wt. 414</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. 24-α-ethylcholesta-5,22-diene-3-β-ol\(^9\)  
   Do  
   C\(_{29}\)H\(_{48}\)O  
   M.wt. 412  
   136-40\(^\circ\)

6. Isofucosterol\(^9\)  
   Do  
   C\(_{29}\)H\(_{48}\)O  
   M.wt. 412  
   137-38\(^\circ\)

7. 24-methylene-25-methylcholesterol\(^9\)  
   Do  
   C\(_{29}\)H\(_{48}\)O  
   M.wt. 412  
   145-49\(^\circ\)

8. β-sitosterol\(^9,10\)  
   D.biflorus  
   (seed)  
   C\(_{29}\)H\(_{50}\)O  
   M.wt. 414  
   139-42\(^\circ\)

9. Stigmasterol\(^9,10\)  
   D.bulbosus  
   (seed)  
   D.lablab  
   (seed)  
   C\(_{29}\)H\(_{48}\)O  
   M.wt. 412  
   165-70\(^\circ\)

It was earlier stated that this genus also contain Δ\(^7\) sterols. Two Δ\(^7\) sterols which were isolated from \(D.\ biflorus\) seed were 24-ethyl-5-α-cholest-7-en-3-β-ol\(^9\) and 24-ethyl-5-α-cholesterol, 22-diene-3-β-ol.\(^9\) Structures of these compounds are as follows.

24-ethyl-5α-cholest-7-en-3-β-ol\(^9\); (C\(_{29}\)H\(_{50}\)O), Mol. Wt. 414; M.pt.152 - 53\(^\circ\)
Besides these seeds of *D. biflorus* also contain one Δ⁹ sterol viz. 24-ethyl-5α-cholester-9(11)ene-3-β-ol⁹ and a triterpene, lupeol.¹¹ Structures of these two compounds are as follows.
Lupeol\textsuperscript{[11]} (C\textsubscript{30}H\textsubscript{50}O); Mol. Wt. 426; M.pt. 215-16°

Not only steroids, but also a number of steroidal growth regulators were isolated from *Dolichos lablab*. After extensive work a group of scientists of Japan reported\textsuperscript{[12-15]} the isolation and structure elucidations of new brassinolide–related steroidal growth regulators from the immature seeds of *D. lablab*. The compounds possess the following skeletons.

**Skeleton-A**

**Skeleton-B**
Structures, molecular formulae and melting points of plant growth regulators possessing skeleton structure (A) are enumerated below.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Compounds</th>
<th>Molecular Formula</th>
<th>Melting Point</th>
<th>Nature of Substituent (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dolichosterone(^{12-15})</td>
<td>(C_{28}H_{46}O_5) Mol. Wt. 462</td>
<td>235-7°</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Homodolichosterone(^{12-15})</td>
<td>(C_{29}H_{48}O_5) Mol. Wt. 476</td>
<td>204-8°</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Castasterone(^{12-15})</td>
<td>(C_{28}H_{48}O_5) Mol. Wt. 464</td>
<td>-- (B.P. 214°)</td>
<td></td>
</tr>
</tbody>
</table>

Another group of plant growth regulators having basic skeleton (B) are listed below along with their formulae, melting points.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Compounds</th>
<th>Molecular Formula</th>
<th>Melting Point</th>
<th>Nature of Substituent (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dolicholide(^{11-14})</td>
<td>(C_{28}H_{46}O_6) Mol. Wt. 478</td>
<td>234-8°</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Homodolicholide(^{11-14})</td>
<td>(C_{29}H_{48}O_6) Mol. Wt. 492</td>
<td>227-8°</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Brassinolide(^{12-15})</td>
<td>(C_{28}H_{48}O_6) Mol. Wt. 480</td>
<td>274-5°</td>
<td></td>
</tr>
</tbody>
</table>
Besides the above growth regulators, presence of another two plant growth regulators in immature seeds of *D. lablab* was also reported. The basic skeleton of these two growth regulators are like skeleton – A where carbonyl oxygen is replaced by two H-atoms. The basic skeleton of these two compounds is as follows.

![Basic skeleton of other two growth regulators](image)

Compounds belonging to the above class are listed below.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Compounds</th>
<th>Molecular Formula</th>
<th>Melting Point</th>
<th>Nature of Substituent (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>6-deoxo-dolichosterone([^{12]})</td>
<td>(C_{28}H_{48}O_4) Mol. Wt. 448</td>
<td>--</td>
<td><img src="image" alt="Substituent" /></td>
</tr>
<tr>
<td>2.</td>
<td>6-deoxo-castasterone([^{12]})</td>
<td>(C_{28}H_{50}O_4) Mol. Wt. 450</td>
<td>--</td>
<td><img src="image" alt="Substituent" /></td>
</tr>
</tbody>
</table>

Immature seeds of *D. lablab* contain growth regulators as well as it is a source of another important compound cytokinin. Generally seeds of higher plants are the important sites of cytokinin biosynthesis and a rich source of cytokinin. Actually this class of compounds are a type of purine derivatives and up till now five cytokinins were isolated\([^{16]}\) from immature seeds of *D. lablab*. Basic skeleton of the compounds is as follows.
A list of cytokinin compounds were described below.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Compounds</th>
<th>Molecular Formula</th>
<th>Nature of Substituent (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Trans Zeatin[16]</td>
<td>C(<em>{10})H(</em>{13})N(_{5})O</td>
<td>(R=R^1=H) (trans to each other)</td>
</tr>
<tr>
<td>2.</td>
<td>6-(trans-4-O-(\beta)-D-glucopyranosyl-3-methyl-2-butenylamino)-purine[16]</td>
<td>C(<em>{16})H(</em>{23})N(<em>{5})O(</em>{6})</td>
<td>(R=O-\beta)-D-glucosyl; (R^1=H)</td>
</tr>
<tr>
<td>3.</td>
<td>6-(trans-4-O-(\beta)-D-glucopyranosyl-3-methyl-2-butenylamino)-9(\beta)-D-ribofuranosylpurine[16]</td>
<td>C(<em>{21})H(</em>{31})N(<em>{5})O(</em>{10})</td>
<td>(R=O-\beta)-D-glucosyl; (R^1=\beta)-D-ribosyl</td>
</tr>
<tr>
<td>4.</td>
<td>Ribosyl-trans-Zeatin[16]</td>
<td>C(<em>{15})H(</em>{21})O(_{4})</td>
<td>(R=H; \ R^1=\beta)-D-ribosyl</td>
</tr>
<tr>
<td>5.</td>
<td>Ribosyl-cis-Zeatin[16]</td>
<td>C(<em>{15})H(</em>{21})N(<em>{4})O(</em>{4})</td>
<td>(R=H; \ R^1=\beta)-D-ribosyl</td>
</tr>
</tbody>
</table>

In addition to the aforesaid growth regulators and cytokinin compounds, a biological active polar substance was isolated\[16\] form the immature seeds of the same variety (\(D.\) lablab) as an amorphous solid. The compound was identified by known methods as a Gibberellin glucoside (3-O-\(\beta\)-D-glucopyranosylgibberellin A\(_1\)).\[17\] The gibberellin showed resistance against \(\beta\)-glucosidase but less active than Gibberellin A\(_1\).\[17\] Structure of the compound is depicted below.
Saponins, complex glycosidic compounds are generally isolated from digitalis plants. Such types of compounds were also found to be present in Dolichos plants. Among all saponins isolated from the genus Dolichos, saponins of D. falcatus draws special attention because total saponin isolated from this plant showed antitumour activity against sarcoma 37[18] and also possess analgesic activity.[19] But attempt to isolate individual component responsible for this remarkable property proves futile. But isolation of saponins from another species viz. D.kilimandscharicus reveals three different saponins which possess molluscicidal and fungicidal properties. All the three saponins (practically three triterpene glycosides) isolated from the roots of D.kilimandscharicus possess noticeable activity both against the mollusc Biomphalaria glabrata (has an importance as an intermediate host in the tropical disease Schistosomiasis)[20] and the fungus Cladosporium cucumerinum.[21] Basic skeleton of all the saponins is same and of the type given below.

Basic skeleton of Saponins from D.kilimandscharicus
Names, molecular formula and nature of the substituents of the saponins possessing the above skeleton structure is as follows.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Compounds</th>
<th>Molecular Formula</th>
<th>Nature of Substituent (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>3-O-β-D-glucopyranoside of hederagenin</td>
<td>C(<em>{30})H(</em>{58})O(_{10}) Mol.Wt.634</td>
<td>R(^1)=H, R(^2)=CH(_2)OH</td>
</tr>
<tr>
<td>2.</td>
<td>3-O-β-D-glucopyranoside of bayogenin</td>
<td>C(<em>{36})H(</em>{58})O(_{10}) Mol.wt.650</td>
<td>R(^1)=OH, R(^2)=CH(_2)OH</td>
</tr>
<tr>
<td>3.</td>
<td>3-O-β-D-glucopyranoside of medicagenic acid</td>
<td>C(<em>{36})H(</em>{56})O(_{11}) Mol.wt. 664</td>
<td>R(^1)=OH, R(^2)=COOH</td>
</tr>
</tbody>
</table>

Saponin crystals were also obtained from the roots of D.falcatus were identified as K-salt of 3-O-β-D-glucopyranoside of medicagenic acid.\(^{[23]}\) Of those three above referred saponins, glycoside of medicagenic acid is most active, followed by glycoside of bayogenin and hederagenin respectively. Beside this, a saponin was established through spectral studies and identified as 3-O-[β-L-rhamnopyranosyl-(1→2) -β-D-glucopyranosyl(1→)]-22-O-[2,3-dihydro-2,5-dihydroxy-6-methyl-4H-pyran-4'-one-(2'→)]-3β,22β,24-trihydroxy-olean-12-en-28-al.\(^{[24]}\)
Another saponin designated as Chikusetsu saponin IVa was isolated from the seeds of hyacinth bean (*D. lablab*).\cite{25}

Although *D. kilimandscharicus* possesses remarkable antifungal activity yet another species of this genus, *Dolichos* *viz.*, *D. marginata* shows similar activity. The active constituents for the former are due to saponins whereas for the later are pterocarpinoids.

Four such pterocarpinoids were isolated from the root bark of *Dolichos marginata*\cite{26} and all possess weak antifungal activity against *Cladosporium cucumerinum*. Their skeletons are given below.

### Pterocarpinoids possessing Structure A.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Compound</th>
<th>Molecular Formula</th>
<th>Nature of Substituents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sphenostylin A\cite{26}</td>
<td>C$<em>{23}$H$</em>{26}$O$_{6}$ Mol.wt. 398</td>
<td>–CH$<em>{3}$ –H –CH$</em>{3}$</td>
</tr>
<tr>
<td>2.</td>
<td>Sphenostylin B\cite{26}</td>
<td>C$<em>{21}$H$</em>{22}$O$_{6}$ Mol.wt. 370</td>
<td>–H –H –H</td>
</tr>
</tbody>
</table>
Pterocarpinoids possessing Structure B.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Compound</th>
<th>Molecular Formula</th>
<th>Nature of Substituents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sphenostylin C^{[26]}</td>
<td>C_{21}H_{24}O_{7}</td>
<td>R^1 = H, R^2 = H, R^3 = H</td>
</tr>
<tr>
<td>2.</td>
<td>Sphenostylin D^{[26]}</td>
<td>C_{22}H_{26}O_{7}</td>
<td>R^1 = H, R^2 = H, R^3 = CH_3</td>
</tr>
</tbody>
</table>

Recent investigation on bacteria treated seeds of *D. biflorus* proves its worth due to isolation of several isoflavones. A close look on isolated isoflavones clearly indicates that these class of compounds can be divided in two distinct classes according to their following skeletons.

Structure – A

Structure – B

Followings are the list and structures of compounds possessing structures A.

Compounds possessing structure A.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Compound</th>
<th>Molecular Formula</th>
<th>Nature of Substituents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Genistein (4',5,7-trihydroxyisoflavone)^{[27]}</td>
<td>C_{15}H_{10}O_{6}</td>
<td>R^1 = OH, R^2 = H</td>
</tr>
<tr>
<td>2.</td>
<td>2'-hydroxy genistein^{[27]} (2',4',5,7-tetrahydroxyisoflavone)</td>
<td>C_{15}H_{10}O_{5}</td>
<td>R^1 = H, R^2 = H</td>
</tr>
<tr>
<td>3.</td>
<td>4',5,7-trihydroxy-2'-methoxy isoflavone^{[27]}</td>
<td>C_{16}H_{12}O_{6}</td>
<td>R^1 = OCH_3, R^2 = H</td>
</tr>
</tbody>
</table>
Compounds possessing Structure B

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Compound</th>
<th>Molecular Formula</th>
<th>Nature of Substituents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Phaseollidin(^{[27,28]})</td>
<td>(C_{20}H_{20}O_4) Mol. Wt. 324</td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td>2.</td>
<td>Dolichin-A(^{[28]})</td>
<td>(C_{20}H_{20}O_5) Mol. Wt. 340</td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
<tr>
<td>3.</td>
<td>Dolichin-B(^{[28]})</td>
<td>(C_{20}H_{20}O_5) Mol. Wt. 340</td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Another isoflavone, Dalbergioidin\(^{[27]}\) whose structure was quite different from other isoflavones and an isoflavone diglycoside, 5-hydroxy-7,3',4'-trimethoxy-8-methyl isoflavone-5-neohesperidoside (\(C_{31}H_{38}O_{15}\))\(^{[29]}\) were also isolated from the seeds of *Dolichos biflorus*. Structures of the isoflavone diglycoside is given below.

*Isoflavone diglycoside (\(C_{31}H_{38}O_{6}\))*

From the flowers of *D. Lablab*, six compounds were isolated and were identified as flavanoids. They are luteolin, cosmsiin, leutolin-4'-O-\(\beta\)-D-glucopyranoside, leutolin-7-O-\(\beta\)-D-glucopyranoside and rhoifolin and another one is a carbohydrate i.e D-manitol.\(^{[30]}\)

As isoflavone, Kievitone \([3-(2',4'-dihydroxy phenyl)-2,3-dihydro-5,7-dihydroxy-8-(3-methyl-2-butenyl)-4H-1-benzopyrone-4-One]\) whose skeleton structure is very similar to that
of structure-A but differs a little (absence of double bond at 2,3 position), was isolated from the seeds of *D. biflorus*. Structure of the compound is as follows.

![Kievitone (C<sub>20</sub>H<sub>20</sub>O<sub>6</sub>)](image)

In 1998 six oleanane type triterpenes bisdesmosides viz. Lablabosides A, B, C, D, E and F were isolated from the seeds of *Dolichos lablab*. The chemical structures of lablaboside A, B, C, D [3 -O -{ α -L - rhamnopyranosil (1→2) - β - D- galactopyranosil (1→2) -β - D - glucopyranosiduronic acid} - 28 - O - {6 - O - (3 - hydroxy - 3 - methylglutaroyl) - β - D - glucopyranosyl } 24 - epi - hederagenin], E [3 -O -{ α -L - rhamnopyranosil (1→2) - β - D- galactopyranosil (1→2) -β - D - glucopyranosiduronic acid} - 28 - O - {α -L - rhamnopyranosil (1→4) -α -L - rhamnopyranosil (1→2) -β - D - glucopranosil} 24 -epi - hederagenin], F [3 -O -{ α -L - rhamnopyranosil (1→2) - β - D- galactopyranosil (1→2) -β - D - glucopyranosiduronic acid} - 28 - O - {α -L - rhamnopyranosil (1→4) -α -L - rhamnopyranosil (1→2) -β - D - glucopranosil} oleanolic acid].

It was well known from the time of Charaka and Sushruta that Kulthi Kalai (*D. biflorus*) seed was extensively used for dissolving kidney stones (popular household remedy for dissolving kidney stones) particularly oxalate stone and was further supported by urolithiatic studies of the plant extract. A few years back, researchers were able to isolate a new diuretic principle, viz. Pyroglutamyglutamine (this compound was referred as a dipeptide) which may be responsible for the removal of the urinary calculi due to oxalate. Structure of the isolated compound is as follows.
Pyroglutamyl glutamine; Molecular formula: C$_{10}$H$_{15}$N$_{3}$O$_{5}$

Mol.wt.257 m.p. 235-37°

As a matter of fact *D. biflorus* seed is not only used for dissolving kidney stones but also used as astringent and possesses antimicrobial activity. Proanthocyanidin compounds$^{35}$ present in the seed undergo hydrolytic and polymerisation reaction in highly acidic alimentary tract and produced condensed tannin which is responsible for its astringenic and antimicrobial property.$^{35}$

Mature seeds of Fabaceae plants are generally found to contain highly basic compounds like aliphatic amines and guanidine compounds.$^{36-41}$ HPLC studies on polyamines of mature seeds of *Dolichos lablab* indicated the presence of two alcohols along with several polyamines$^{42}$. Two amino alcohols so far isolated were identified as N-(3-amino-propyl)-aminoethanol [NH$_2$(CH$_2$)$_3$NH(CH$_2$)$_2$OH]$^{42}$ and N-(3-aminopropyl)-aminopropanol [NH$_2$(CH$_2$)$_3$NH(CH$_2$)$_3$OH]$^{32}$ and the polyamines were diamino propane [NH$_2$(CH$_2$)$_3$NH$_2$]$^{42}$, putrescine [NH$_2$(CH$_2$)$_4$NH$_2$]$^{42}$, spermidine [NH$_2$(CH$_2$)$_3$NH(CH$_2$)$_3$NH$_2$], spermine [NH$_2$(CH$_2$)$_3$NH(CH$_2$)$_4$NH(CH$_2$)$_3$NH$_2$]$^{42}$, thermospermine$^{42}$ and aminopropylhomospermidine [NH$_2$(CH$_2$)$_3$NH(CH$_2$)$_4$NH(CH$_2$)$_4$NH$_2$].$^{42}$

In course of studies of free amino acids on the genus *Dolichos*, a dipeptide, γ-glutamylphenyl-alanine$^{41}$ was isolated in several species of African origin viz. *D.sericeus* of Rwanda, *D.sericeus* and *D.glabresceus* of Zambia and *D.trilobus* of Kenya.

It may be noted here that very few attempts have been made on the seed proteins of the genus *Dolichos*. Only the globulin fraction of the seeds of *Dolichos biflorus* was isolated and analysed for the estimation of a few amino acids (Lysine, Arginine, Histidine, Tyrosine,
Tryptophan and Cystine). A publication which reported the quantitative values of amino acids by paper chromatography of some Indian pulses including *D. biflorus* (Horse gram) with their protein contents was also found in the literature survey. Compositional studies on legumes showed the presence of about ~30% protein and all amino acids except lysine and methionine in the seeds of *D. lablab*. It is worth to mention that the presence of an unusual enzyme, Allantoinase in *D. biflorus* seed was isolated and purified 62-fold. Its activity was demonstrated in the resting seed, and increased linearly with time during the first 5 days of seedling growth.

It was stated earlier that the genus *Dolichos* was extensively studied for lectins which were oligomers of different functional properties and consequently made up of smaller subunits. It is well known that plant lectins find tremendous applications in medicines, research and industries due to their carbohydrate binding properties. Plant lectins also furnish hydrophobic binding sites because of the presence of carbohydrate moieties, may bind several types of compounds and groups and in this process several class of compounds are obtained. Lectins of the seeds of *D. biflorus* may be stated as example.

Of all the species so far known, only two, *Dolichos biflorus* and *Dolichos lablab* proved themselves to be the potential sources of lectins. Extensive research on *D. lablab* lead to the successful isolation and characterization of two types of haematogglutinin viz. A and B. It was revealed that haematogglutinin A was insoluble in water, contained 9.9% carbohydrate and had no antitryptic property. On the other hand, haematogglutinin B, having antipyretic property, was soluble in water, contained 13.9% carbohydrate. One of the remarkable features of these haematogglutinins is that it can inhibit the growth of rats by feeding a diet containing 0.5 to 2.5% A variety. Soon after, it was observed that seeds of *D. biflorus* also contained an agglutinin which was able to react with streptococci of serological group C. That was a glycoprotein of molecular weight 130,000 and contained 19 amino acids, 0.5% galactose, 0.2% mannose together with trace amount of ramnose and fucose. Later on, another lectin (plant agglutinin) was isolated from *D. biflorus* seed which was specific for human blood group A. Its molecular weight was found to be 146,000 containing 2% hexose, large amount of aspartic acid and alanine. But no cysteine and methionine were present therein. Subsequently, the molecular weight of this lectin was corrected and found to be 120,000 (not 146,000) which was a tetramer of four identical subunits of molecular weight 30,000. It was also observed that alanine was the N-terminal...
amino acid.\textsuperscript{[58-61]} Similarly, lectin from \textit{D. lablab} seeds of molecular weight 110,000 was composed of two pairs of two types of subunits of molecular weights 16,000 and 40,000 respectively. Presence of 2\% neutral sugar in this lectin was also reported.\textsuperscript{[61]} Another non-specific lectin of comparatively low molecular weight (mol. wt. 60,000) was also isolated from the seeds of \textit{D. lablab}, also a tetramer of four identical subunits of molecular weight 15,000\textsuperscript{[62]}. Fucose, mannose and N-acetylglucosamine were present in the above lectin. It’s N-terminal and C-terminal amino acids were found to be alanine and serine respectively.\textsuperscript{[62]} Methionine and cysteine were practically absent in the above lectin.\textsuperscript{[57]} Recently, a non-specific lectin\textsuperscript{[63]} was isolated from \textit{D. biflorus} seed where N-acetylglucosamine-N-β-glycoside was present as carbohydrate which was linked with the amino acid, asparagine of the protein chain.

Some lectins were also isolated from other parts of the plants. A lectin was isolated from the roots of 7 days old \textit{D. biflorus} plant.\textsuperscript{[64]} Besides this root lectin, two vegetative tissue lectins DB 58 and DB 46 were isolated from \textit{D. biflorus}.\textsuperscript{[60]} Among these two, DB 58 was also isolated from the stems and leaves of \textit{D. biflorus}.\textsuperscript{[66]}

It is of no doubt that malnutrition is a curse to the people of third world countries. Population explosion and poor economic growth are the main factors of this situation. Peoples of India particularly low income group consume the seeds of \textit{D. biflorus} almost regularly as an alternative of lentil seeds, which is rich in protein. Literature survey indicates scantily works have been made on \textit{D. biflorus} seed protein. Work\textsuperscript{[67]} on this seed protein clearly shows that this is a non-toxic protein and contains 17 amino acid of which 9 are essential. This seed protein is a mixture of 8 units/sub-units. Of these units/sub-units, two have molecular weights are well above 1,00,000 and others have low molecular weights and thus it may be easily digestible.

As different parts of \textit{D. biflorus} are used as folk medicine, but there is no evidence to use any constituent isolated from this seed directly or indirectly as antihepatotoxic agent in the literature. It may be noted here that it has already been proved that methanolic extract of \textit{D. biflorus} seed possesses anti-bacterial action (both gm +ve and gm –ve).\textsuperscript{[68]} Further work on \textit{D. biflorus} seed provide a support to the use of Kulthy as an antihepatotoxic agent.\textsuperscript{[69]}
REFERENCES

6. Asima Chatterjee and Satyesh Chandra Pakrashi, “The Treatise on Indian Medicinal Plants” (Publication and Information Directorate, CSIR, New Delhi), 1992; 90, 91, 93, 130.
51. T. C. Moore, “Biochemistry and Physiology of Plant Hormone” (Springer Verlag, New York), 156-195.