RESEARCH ARTICLE

Checklist of Plants Used as Blood Glucose Level Regulators and Phytochemical Screening of Five Selected Leguminous Species

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ABSTRACT
In the first part of this study, literature survey of plants recorded to regulate glucose level in blood was carried out. Result of this part includes their chemical constitutes and use in the different body disorders other than diabetes. 48 plants species are collected from the available literature and presented in the form of a checklist. The second part of this work is a qualitative phytochemical screening of seeds selected from the family Fabaceae, namely: Bauhinia rufescens, Senna alexandrina, Cicer arietinum, Lupinus albus, and Trigonella foenum-graecum. The studied plants are extracted in petroleum ether, water, and ethanol and different phytochemicals are detected in the extract. Alkaloids are present in all plants in the different extract, but their concentration is high in T. foenum-graecum and B. rufescens. Glycosides are highly detected in S. alexandrina and L. albus. Flavonoid is highly detected in B. rufescens, Senna and C. arietinum, and L. albus. Phenolic compound is not detected in all extract of the five plants. Saponin is observed in all plant put highly detected in L. albus. Tannin detected in Senna alexandrina. Resins are observed in plants but highly detected in C. arietinum, L. albus, and T. foenum-graecum. Terpenes are observed in all plant put highly in T. foenum-graecum. Protein: results of protein in the studied plant did not give accurate observations as expected. Alkaloids and proteins are the main components known to increase glucose levels in the blood.

Key words: Plants, blood glucose, phytochemical screening

GENERAL INTRODUCTION
Plants used since ancient time by human and his animals as: Source of food, medicine, energy in form of fuel and, gas, building materials (insulation providing insulation against extremes of temperature, sound or electricity, pipes for carrying water, pitch used for waterproofing, and in paints.), clothing, dyes, paints, inks and paper, fertilizers, fire and lighting, pesticides, and woodwork.[1]

Objective
The objectives are as follows:
1. Literature survey of plants recorded to be used as blood glucose level control (diabetes).

2. Phytochemical screening of five selected leguminous plant commonly used to control diabetes.

LITERATURE REVIEW
Phytochemistry
Phytochemistry is the study of phytochemicals which are derived from the plant; these phytochemicals are secondary metabolic compound [Figure 1]. Phytochemistry is widely used in the field of Sudan medicine especially in the field of herbal medicine [Figures 2-4]. A phytochemical is a natural bioactive compound found in plant foods that works with nutrients and dietary fiber to protect against disease [Figures 4-6].[2]
Alkaloids
Alkaloids are natural compounds, basic natural products are occurring primarily in many plants usually colorless, but often optically active substances [Figure 7-10]. Most are crystalline, but a few are liquid at room temperature and have bitter tastes. [3]

Glycosides
Glycosides are molecules consist of sugar and non-carbohydrates usually small organic molecule. Many plant store chemicals in the form of in active glycoside [Figures 11 and 12]. [4]

Phenolic compounds
Phenolic compounds are the largest and most ubiquitous groups of plant metabolites that possess an aromatic ring bearing one or more hydroxyl (OH) constituents (Singh et al., 1998), and are a member of a group of aromatic chemical compounds with weakly acidic properties, and are characterized by a OH group attached directly to an aromatic ring [Figures 2-4]. [5]

Tannins
Tannin is a general descriptive name for a group of polymeric/phenolic substances capable of tanning leather or precipitating gelatin from a solution, a property known as astringency [Figures 13-15]. [6]

Flavonoids
Flavonoids are a group of phytochemicals found in varying amounts in foods and medicinal plants which have been shown to exert potent antioxidant activity against the superoxide radical. [3]

Terpenoids
Terpenoids are the largest class of plant natural products (Trapp, 2001) and more than 30,000 terpenoid compounds have been identified, terpenoids such as essential oils and resins have commercial and industrial values. [7] The main function of terpenes and their derivatives is widely recognized in the plant defense mechanism.

Diabetes
Of diabetes is a chronic endocrine (lifelong) disease marked by high levels of glucose in the blood. People with diabetes have high blood sugar. This is because:

- Their pancreas does not make enough insulin
- Their muscle, fat, and liver cells do not respond to insulin normally
- Both of the above.

The role of insulin is to move glucose from the bloodstream into muscle, fat, and liver cells, where it can be used as fuel (PubMed, 2010).

There are three major types of diabetes

Type 1 diabetes
It is usually diagnosed in childhood characterized by insulin deficiency, daily injections of insulin are needed. The exact cause is unknown. Genetics, viruses, and autoimmune problems may play a role (PubMed, 2010).

Type 2 diabetes
It usually occurs in adulthood, but young people are increasingly being diagnosed with this disease. Many people with type 2 diabetes do not know...
they have it, although it is a serious condition (PubMed, 2010). Hence, they presented first time with complication (Nicolas et al., 2006). Type 2 diabetes is becoming more common due to increasing obesity and failure to exercise (PubMed, 2010).

Gestational diabetes
Gestational diabetes is high blood glucose that develops at any time during pregnancy in a woman who does not have diabetes (PubMed, 2010). Women who have gestational diabetes are at high risk of type 2 diabetes and cardiovascular disease later in life (PubMed, 2010).
Prevalence of diabetes
Diabetes is affecting more than 100 million people worldwide and the World Health Organization predicts this number will increase five-fold in the near future.\[8\]

Treatment of diabetes
There is no cure for diabetes. Treatment involves diet and exercise, oral antidiabetic medication and insulin, although the treatment goals that can help people to maintain their normal live (PubMed, 2011).

The medications which are given to diabetic patient vary according to diabetes type: patients who have type 1 must take insulin pumping or
injection, while people with type 2 take oral anti
diabetic drugs such as sulfonylureas.
Most women with gestational diabetes control it with meal planning and physical activity. However, some women need insulin to reach their target blood glucose levels.
Diabetes medications have side effect such as low blood sugar weight gain nausea,[9-12] they can even cause your death. More than 2.1 million people are
injured, experiencing adverse drug reaction, and more than 105,000 people die every year due to the prescription drugs.[13-15] Although insulin is the most common conventional treatment for diabetes, diet therapy approaches have demonstrated many advantages in developing countries.[16] Because diabetes medication has side effects, the world goes through another types of treatment to reduce these effects, so they use traditional medicine.
Different plant families such as Asteraceae (*Ambrosia maritima*) and Asclepiadaceae (*Solenostemma argel*), Alliaceae/Liliaceae (*Allium cepa*), and Fabaceae/Leguminosae (*Lupinus albus*) are commonly used as diabetes medications.

**Fabaceae/Leguminosae**

**Botanical classification**

- **Kingdom:** Plantae
- **Subkingdom:** Tracheobionta
- **Super division:** Spermatophyta
- **Division:** Magnoliophyta
- **Class:** Magnoliopsida
- **Sub class:** Rosidae
- **Order:** Fabales
- **Family:** Fabaceae.

Fabaceae or Leguminosae is widely distributed family with many different species 17,000 which are found throughout the world. Leguminosae seeds have a higher amount of protein so they are used as a source of protein in the world especially in developing countries, legume also used in a crop rotation to replenish soil that has been depleted of nitrogen. The seeds are used for human and animal consumption or the production of oils for industrial uses.[17,19]

Leguminosae species used for different purposes such as industrial production include *Indigofera*, cultivated for the production of indigo, *Acacia nilotica*, for gum arabic, and *Derris* sp., for the insecticide action of rotenone and nutritional foods. Furthermore, many genus of Fabaceae according to records used as medicinal plants for the treatment of diseases such as desyntrre, asthmatic, and diabetes (Plant Families, 2010).

**Fabaceae can be divided into three subfamily**

1. **Caesalpinioideae**
2. **Mimosoideae**
3. **Papilionidae**

Diabetes control by different plant parts: leaves, roots, and seeds, such as *Lupinus* species this study doing seeds because its storage part in the plant, which has a higher amount of effective substances which recorded to be control diabetes. These plants are five species selected from Fabaceae which are: *Senna alexandrina, L. albus, Bauhinia rufescens, Cicer arietinum,* and *Trigonella foenum-graecum*. Botanical medications have increased every year. It is estimated that 60–70% of the American population is taking botanical products, but less than one-third of these persons inform their medical practitioners of such use.[20]

**Plants used in this study**

Five species from the family Fabaceae are selected in this study *B. rufescens* and *S. alexandrina* from subfamily *Caesalpinioideae*, and *C. aritenium, L. albus,* and *T. foenum-graecum* from subfamily *Papilionidae*.

**B. rufescens**

**Distribution**

The plant is distributed in the sub-Himalayan tracts from the Indus eastwards and throughout the dry forests of India, ascending to 1300 m. It is also cultivated throughout the plains.[21]

**Botanical description**

Botanical description is a shrub, native to semi-arid areas of Africa. It is usually 1–3 m high but can grow to 8 m. It appears to have thorns which are actually leafless shoots. Leaves are a deep shade of green. Seeds in bunches of dark brown pods.

**Phytochemical constitute**

Glycosides isolated from flowers, coumarine, flavonoid,[22,23] tannins, saponins, cardiac glycosides, sterols, and terpenes.[24]

**Traditional uses**

Diabetes (El Ghazali et al.,1998), Malaria, trachoma, uterus cyst, fibroma, syphilis, common dropsi, yellow fever, icterus, decoction of roots of *Bauhinia rufescens* diarrhea, dysentery stomachic, maceration of leaves of Bauhinia or to cook with millet flour, and goat milk.[25]

The leaves of *B. rufescens* are also used for diabetes oral administration of water extract (decoction and maceration) in a dose of 1 g/kg, ethanolic (95%) in doses 500, 2000 mg/kg, ethanolic (75%) in doses 200, 1000 mg/kg, and dichloromethane extract in a dose of 1 g/kg body weight did not cause any decrease in plasma glucose levels of treated rats. Only petroleum ether extract of leaves of *B. rufescens* in doses of 1 or 2 g/kg body weight showed significant non-dose-dependent hypoglycemic.
Hypoglycemic activity of aqueous extracts from *Bauhinia forficata* L. and *Bauhinia monandra* Kurz leaves (10% w/v) was evaluated in normoglycemic mice. Both extracts have shown hypoglycemic activity.\textsuperscript{[26-28]}

A new flavone rhamnopyranoside has been isolated from this genus. Previous chemical investigations have focused on the isolated hypoglycemic and antioxidant kaempferol dirhamnoside from *B. forficata*, a traditional antidiabetic treatment in Brazil, while hypoglycemic flavonoid-containing fractions have been isolated from leaves of Egyptian *B. purpurea*.\textsuperscript{[29]}

**Senna alexandrina**

*Distribution*

*S. alexandria* is also known as *Cassia senna* and *Cassia angustifolia*. *Senna* is a shrub native to Egypt, Sudan, Nigeria and Nubba in North Africa, as well as India and China.\textsuperscript{[30,31]}

*Botanical description*

*C. senna* is a shrub or undershrub, 60–75 cm in height with the pale substrate or obtusely angled erect or spreading branches. Leaves are paripinnate. Leaflets are 5–8 in number, ovate-lanceolate and glabrous. Flowers are yellowish, many and arranged in axillary racemes. Fruits are flat legumes, greenish brown to dark brown and nearly smooth.\textsuperscript{[32,33]}

*Phytochemical constitute*

Anthraquinone glycosides are known as sennosides (A, B), cathartic acid rhein (glycoside) (Global herbal supplies. 2009). Flowers contain flavonoids-kaempferol-3-galactoside and kaempferol-3-rhamnoglucoside. Stem bark yields hentriacontane, octacosanol, and stigmasterol. Stem yields \(\beta\)-sitosterol, lupeol, and a flavanone glycoside-5, 7-dimethoxy flavanone-4-O-\(\alpha\)-L-rhamnopyranoside-\(\beta\)-D-glucopyranoside. Seeds possess human blood agglutinating activity. The stem bark is hypothermic, central nervous system (CNS) active, and depressant. Bud, flower, leaf, and stem bark are antibacterial. Stem possesses juvenoid activity. Bark is alterative, tonic, antielprotic, and antiurheumatic. Bud is antidysenteric. Root is carminative and antidote for snakebite. Bark, flower, and root promote suppuration. Bark and bud are astringent and vermifuge (Husain *et al.*, 1992).

**Traditional uses**

An extract of the root is used as an astringent or antipyretic in local (folk) medicine. Leaves and fruit are applied for the treatment of diarrhea, dysentery, and ophthalmalic diseases. The bark of the roots and trunk is used to cure chest complaints, syphilis, and other venereal diseases, leprosy, diarrhea, and dysentery and to reduce fever.

*Food:* In Ghana, farmers, hunters and field workers eat the wild fruits. In Sudan, the fiber is extracted for cordage.\textsuperscript{[34]}

Seeds used for diabetes (El Ghazali *et al.*, 1998) other species of cassia have been reported for diabetes control such as *C. occidentalis*. Ethanolic extract of *C. occidentalis* produced a significant reduction in fasting blood glucose levels in the normal and alloxan-induced diabetic rats at doses of 100 and 200 mg/kg body weight.\textsuperscript{[35]} Furthermore, cassia fistula reported as antidiabetic.\textsuperscript{[36-39]}

*Cassia angustifolia* (Senna) leaves have an effect on the fasting blood sugar in a sample of mild diabetic Yemeni patients (AL-adhal, 2009).

*S. alexandrina* had alpha-amylase inhibitory activity and alpha-glucosidase enzymes found in polarity extracts which is increase insulin secretion.\textsuperscript{[40-42]}

**C. artienum**

*Botanical description*

An erect or spreading, much branched annual; leaves imparipinnately compound, leaflets small, oval, all parts covered over with glandular hairs, inflorescence stalk jointed about the middle: flowers pink, blue, or white: fruits turgid, pubescent pods; seeds reddish brown, black or white, subglobose or obovate with a beak (Medicinal plants.com.2011).

*Distribution*

*C. arietinum* is grown in the Mediterranean, Western Asia, the Indian subcontinent and Australia, is cultivated in other countries such as Canada and England.\textsuperscript{[43,44]}

*Phytochemical constitute*

Carbohydrates and proteins, which constitute about 80% of the total dry seed weight. Dried chickpeas contain about 20% protein. The bulk of the seed is made up of carbohydrates (61%) and 5% fat (Azila, 2007).
### Table 1: Checklist of plants used as blood sugar control

<table>
<thead>
<tr>
<th>Family</th>
<th>Genus</th>
<th>Local name</th>
<th>Part use</th>
<th>Chemical constitute</th>
<th>Traditional uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aloaceae</td>
<td><em>Aloe</em> spp.</td>
<td>Sappar</td>
<td>Leaves</td>
<td>Anthraquinone-barbatonin</td>
<td>Treatment for fevers - the pain of the colon - aching joints - hemorrhoids - worms - dermatology</td>
</tr>
<tr>
<td>Alliaceae</td>
<td><em>Allium cepa</em></td>
<td>Basal</td>
<td>Pulp</td>
<td>Flavonoid-steroid-phenolic compound-vitamins-volatile oil</td>
<td>Antimicrobial- paperboard blood - hair loss - for the treatment of ear pain - a diuretic urine</td>
</tr>
<tr>
<td></td>
<td><em>Allium sativum</em></td>
<td>Thoum</td>
<td>Pulp</td>
<td>Allicin-volatile oil</td>
<td>Anthelmintic - a cure for kierdia - treatment of wounds - amad gum - blood pressure - lowers cholesterol – hemorrhoids</td>
</tr>
<tr>
<td>Asclepiadiaceae</td>
<td><em>Solenostemma argel</em></td>
<td>Hargel</td>
<td>leaves</td>
<td>Glycoside steroid flavonoid saponin</td>
<td>Colic - repelling gas - poor digestion - total infections – measles</td>
</tr>
<tr>
<td>Asteraceae</td>
<td><em>Ambrosia maritima</em></td>
<td>Demsisa</td>
<td>Whole plant</td>
<td>Terpenoid</td>
<td>Treatment of diabetes - kidney infections - venereal disease - blood pressure.</td>
</tr>
<tr>
<td></td>
<td><em>Anthemis pseudocotula</em></td>
<td>Rebian</td>
<td>Flower</td>
<td>-</td>
<td>Anti-fungal - anti-cancer</td>
</tr>
<tr>
<td></td>
<td><em>Artemisia arborescens</em></td>
<td>Shegerat</td>
<td>leaves</td>
<td>-</td>
<td>Stomach ache - the bites of snakes and scorpions read phonetically dictionary</td>
</tr>
<tr>
<td></td>
<td><em>Centaurea alexandrina</em></td>
<td>Morr</td>
<td>Flower</td>
<td>-</td>
<td>Antibacterial</td>
</tr>
<tr>
<td></td>
<td><em>Erigain monanthensis</em></td>
<td>Hashat el</td>
<td>Fruits –leaves</td>
<td>Tannin –flavonoid</td>
<td>Anti-inflammation of the throat -internal bleeding – diabetes</td>
</tr>
<tr>
<td></td>
<td><em>Cynara scdymus</em></td>
<td>Harshuoof</td>
<td>Seeds</td>
<td>Volatile oil</td>
<td>Lowers claustral - and diabetes</td>
</tr>
<tr>
<td></td>
<td><em>Lactuca sativa</em></td>
<td>Khas</td>
<td>Leaves</td>
<td>-</td>
<td>Nervous laxative and analgesic</td>
</tr>
<tr>
<td></td>
<td><em>Centaurea calcitrarpa</em></td>
<td>Hasak</td>
<td>Whole plant</td>
<td>Saponin</td>
<td>Treatment for fever - an antibiotic</td>
</tr>
<tr>
<td>Balanitaceae</td>
<td><em>Balanites aegyptiaca</em></td>
<td>Higlig</td>
<td>Root-stem-Fruit</td>
<td>Root: Rotenone, yamogenin Stem: Rotenone coumarine Fruit: Steroid, flavonoid, diosgenin, yamogenin</td>
<td>Treatment for diabetes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combertaceae</td>
<td><em>Guiera senegalensis</em></td>
<td>Gobaish</td>
<td>leaves</td>
<td>Flavonoid-alkaloid-saponin-mucilages</td>
<td>Hemorrhoids Treatment - Dermatology - Eczema - humidity - pulmonary tuberculosis - a strong laxative - hair loss</td>
</tr>
<tr>
<td>Cruciferiae</td>
<td><em>Carica papaya</em></td>
<td>Papay</td>
<td>Fruits</td>
<td>Alkaloid</td>
<td>Anti-worms</td>
</tr>
<tr>
<td>Cruciferiae</td>
<td><em>Nasturtium officinale</em></td>
<td>Rashad</td>
<td>Whole plant</td>
<td>-</td>
<td>Serum for scorpion sting - Bronchitis - appetizing – Dermatology</td>
</tr>
<tr>
<td>Cucurbitaceae</td>
<td><em>Cucumis sativas</em></td>
<td>Khiar</td>
<td>Fruits</td>
<td>-</td>
<td>Fever - the abode of the headache</td>
</tr>
<tr>
<td>Cucurbitaceae</td>
<td><em>Eruca sativa</em></td>
<td>Geggger</td>
<td>Leaves</td>
<td>-</td>
<td>Ointment for burns</td>
</tr>
<tr>
<td></td>
<td><em>Bryonia alba</em></td>
<td>Ulag</td>
<td>Roots</td>
<td>Alkaloids</td>
<td>Diabetes control</td>
</tr>
<tr>
<td></td>
<td><em>Citrullas colocynthis</em></td>
<td>Handdal</td>
<td>Seeds -fruits</td>
<td>Flavonoid-cucurbitacin-alkaloid-glycoside-saponin</td>
<td>For the treatment of fever - Skhanpbatn - leather illnesses - the mother of the colon - constipation - Hemorrhoids - aching joints - hair loss. Listen read phonetically</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Bryonia cretica</em></td>
<td>Ulag</td>
<td>Roots</td>
<td>Alkaloid</td>
<td>A cure for diabetes - disinfectant for bacteria</td>
</tr>
<tr>
<td>Fabaceae</td>
<td><em>Glycine hispida</em></td>
<td>Fool soia</td>
<td>Seeds</td>
<td>Saponin –flavonoid</td>
<td>A cure for diabetes</td>
</tr>
<tr>
<td></td>
<td><em>Senna alexandrina</em></td>
<td>Sanamaka</td>
<td>Seeds</td>
<td>Glycosides</td>
<td>Anti-diarrhea - hemorrhoids – diabetes</td>
</tr>
<tr>
<td></td>
<td><em>Pisum sativum</em></td>
<td>Besella</td>
<td>Seeds</td>
<td>Alkaloid</td>
<td>Treatment -inflammation of brain membranes</td>
</tr>
<tr>
<td></td>
<td><em>Cicer arietinum</em></td>
<td>Hormos</td>
<td>Fruits</td>
<td>Volatile oil-starch-amino acid</td>
<td>Remove obesity</td>
</tr>
</tbody>
</table>

(Contd...)
Table 1: Continued

<table>
<thead>
<tr>
<th>Family</th>
<th>Genus</th>
<th>Local name</th>
<th>Part use</th>
<th>Chemical constitute</th>
<th>Traditional uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lupinus albus</strong></td>
<td>Tormos</td>
<td>Seeds</td>
<td>Alkaloid</td>
<td>Freshness of the epidermis - skin infections - fractions – cosmetics</td>
<td></td>
</tr>
<tr>
<td><strong>Bauhinia rufescens</strong></td>
<td>Kolkol</td>
<td>leaves</td>
<td>Glycoside-flavonoid</td>
<td>Treatment for diabetes</td>
<td></td>
</tr>
<tr>
<td><strong>Trienolla foenu</strong></td>
<td>Hilba</td>
<td>Seeds</td>
<td>Alkaloid-flavonoid-saponin-fixed oil – volatile oil-vitamin</td>
<td>Abdominal pain and diarrhea - dysentery - infections of the total - arthritis - milk production - oncology - newsletter – colic</td>
<td></td>
</tr>
<tr>
<td><strong>Geraniaceae</strong></td>
<td>Geranium robertianum</td>
<td>Etr alhab</td>
<td>Flower-seeds</td>
<td>-</td>
<td>Infections of the throat – infections of almonds - a cure for bleeding - Treatment of diarrhea</td>
</tr>
<tr>
<td><strong>Erodium cicutarium</strong></td>
<td>Dohmat abubaker</td>
<td>Flowers</td>
<td>Saponin</td>
<td>Diuretic - to stop the bleeding of the wound healing</td>
<td></td>
</tr>
<tr>
<td><strong>Juglandaceae</strong></td>
<td>Juglans regia</td>
<td>Djous</td>
<td>Fruit</td>
<td>For the treatment of breathlessness - the flu - an anti-bites of scorpions and snakes - inflammation of the teeth.</td>
<td></td>
</tr>
<tr>
<td><strong>Lamiaceae/Labiatae</strong></td>
<td>Marrubium vulgare</td>
<td>Om robuia</td>
<td>Leaves</td>
<td>-</td>
<td>Treatment of jaundice - eczema - typhoid - fever - liver diseases - respiratory diseases</td>
</tr>
<tr>
<td><strong>Lauraceae</strong></td>
<td>Cinnamomum verum</td>
<td>Gerfa</td>
<td>Cortex</td>
<td>Volatile oil-terpenoid-eugenol</td>
<td>Kidney disease - a tonic for memory - expectorant - for the treatment of cough and asthma – menstrual pain</td>
</tr>
<tr>
<td><strong>Moringaceae</strong></td>
<td>Moringa oleifera</td>
<td>Shagart alrwag</td>
<td>leaves</td>
<td>Glycosides</td>
<td>Diabetes control</td>
</tr>
<tr>
<td><strong>Oleaceae</strong></td>
<td>Olea europaea</td>
<td>Zaytoun</td>
<td>Leaves-fruits</td>
<td>Volatile oil</td>
<td>Treatment for cough - a cure for rheumatism</td>
</tr>
<tr>
<td><strong>Poaceae/Gramineae</strong></td>
<td>Hordeum vulgare</td>
<td>Shaer</td>
<td>Grains</td>
<td>Protien.</td>
<td>Kidney stones renal - kidney infections</td>
</tr>
<tr>
<td><strong>Portulacaceae</strong></td>
<td>Portulaca oleracea</td>
<td>Regal</td>
<td>Whole plant</td>
<td>-</td>
<td>Remove crusts from the eyes</td>
</tr>
<tr>
<td><strong>Papaveraceae</strong></td>
<td>Chelidonium majus</td>
<td>Orog sapaggen</td>
<td>Roots</td>
<td>Alkaloids</td>
<td>Catarrh - back pain - diabetes - Blockage of a toothache liver - jaundice - the evacuation of sight</td>
</tr>
<tr>
<td><strong>Ranunculaceae</strong></td>
<td>Nigella sativa</td>
<td>Kamoun</td>
<td>Seeds</td>
<td>Glycoside-volatile oil-fixed oil</td>
<td>Treatment for blood pressure - the mother ureret - the mother of the colon - sore - alkierdia - get rid of tapeworms - skin diseases and respiratory sinus</td>
</tr>
<tr>
<td><strong>Rubiacae</strong></td>
<td>Vangueria madagascariensis</td>
<td>Erg almahal</td>
<td>Leaves-seeds</td>
<td>Staric cid-palmatic acid-olevic</td>
<td>Diabetes control</td>
</tr>
<tr>
<td><strong>Rutaceae</strong></td>
<td>Citrus aurantifolia</td>
<td>Laymon</td>
<td>Fruits</td>
<td>Terpenoid –tri terpenoid-volatile oil</td>
<td>Treatment of rheumatism - kidney disease, sedative kidney stones- and diuretic milk - an anti-tumor growth - an antibiotic</td>
</tr>
<tr>
<td><strong>Rosaceae</strong></td>
<td>Eriobotrya japonica</td>
<td>Bashmella</td>
<td>Fruits-leaves</td>
<td>Tannin –saponin</td>
<td>Diabetes - cough - rheumatism - Kidney stones</td>
</tr>
<tr>
<td><strong>Apiaceae/ Umbelliferae</strong></td>
<td>Apium graveolens</td>
<td>Karfas</td>
<td>Leaves</td>
<td>oil</td>
<td>Treatment for gout - anemia and diabetes</td>
</tr>
<tr>
<td>****</td>
<td>Coriandrum sativum</td>
<td>Kashara</td>
<td>Seeds</td>
<td>-</td>
<td>Scabies - sores and diabetes</td>
</tr>
<tr>
<td>****</td>
<td>Daucus carota</td>
<td>Gezar</td>
<td>Glycosides</td>
<td>Divisions cancer - cold diarrhea, diabetes, kidney stones</td>
<td></td>
</tr>
<tr>
<td><strong>Zygophyllaceae</strong></td>
<td>Zygophyllum coccineum</td>
<td>Kanon karamani</td>
<td>Seeds</td>
<td>-</td>
<td>Treatment for rheumatism - quazot - asthma - high blood pressure - Read phonetically dictionary</td>
</tr>
</tbody>
</table>
Ibrahim, et al.: Checklist of Plants Used as Blood Glucose Level

Table 2: Qualitative analysis of Bauhinia rufescens

<table>
<thead>
<tr>
<th>Name of test</th>
<th>Water extract</th>
<th>Ether extract</th>
<th>Ethanol extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloid</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Glycoside</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Flavonoid</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Phenol</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Saponin</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tannin</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Resin</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Terpene</td>
<td>–</td>
<td>–</td>
<td>++</td>
</tr>
<tr>
<td>Protein</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Table 3: Qualitative analysis of Senna alexandrina

<table>
<thead>
<tr>
<th>Name of test</th>
<th>Water extract</th>
<th>Ether extract</th>
<th>Ethanol extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloid</td>
<td>–</td>
<td>–</td>
<td>++</td>
</tr>
<tr>
<td>Glycoside</td>
<td>+</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Flavonoid</td>
<td>–</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Phenol</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Saponin</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tannin</td>
<td>–</td>
<td>–</td>
<td>++</td>
</tr>
<tr>
<td>Resin</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Terpene</td>
<td>–</td>
<td>–</td>
<td>++</td>
</tr>
<tr>
<td>Protein</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Table 4: Qualitative analysis of Cicer arietinum

<table>
<thead>
<tr>
<th>Name of test</th>
<th>Water extract</th>
<th>Ether extract</th>
<th>Ethanol extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloid</td>
<td>+</td>
<td>++</td>
<td>–</td>
</tr>
<tr>
<td>Glycoside</td>
<td>++</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Flavonoid</td>
<td>++</td>
<td>++</td>
<td>–</td>
</tr>
<tr>
<td>Phenol</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Saponin</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tannin</td>
<td>+</td>
<td>–</td>
<td>++</td>
</tr>
<tr>
<td>Resin</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Terpene</td>
<td>–</td>
<td>–</td>
<td>++</td>
</tr>
<tr>
<td>Protein</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

C. arietinum used as antidiabetic (El Ghazali et al., 1998).
The effect of oral administration of check pea seed for 8 weeks on diabetic rats decreased blood glucose level.[45]

L. albus

Botanical description

L. albus (Linn.) is a native of Southern Europe and adjacent Asia, Africa a plant of about two feet high, with leaves cut palmately into five or seven divisions, 1–2 inches long, smooth above, and white, hairy, and beneath. The flowers are in terminal racemes, on short footstalks, white and rather large, the pod 3–4 inches long, flattish, containing three to six white, circular, flattish seeds, which have a bitter taste(Botonical.com, 2011 and Kurlovich, 2002).

Distribution

It is probably of Egyptian or East Mediterranean origin of Africa, represented in Europe, Asia,
and North and South America and some region of Brazil (Williamson, 1993 and Gladstones, 1998).

Phytochemical content
The bitter principle lupinin is a glucoside occurring in yellowish needles. On boiling with dilute acids, it is decomposed into Lupigenin and fermentable glucose (Botonical.com, 2011). Willstatter described the following alkaloids as occurring in L. albus Lupanine.

Traditional uses
Fractures (El Ghazali et al., 1998) used as an external application to ulcers, and internally are anthelmintic, diuretic, and emmenagogue antiparasitic worms (Botonical.com, 2011). According to Schwartz (1906), the seeds of Lupinus arabicus contain a crystalline substance to which he gave the name of Magolan, which is a useful remedy in diabetes mellitus (Botonical.com, 2011).

Conglutin γ, a lupin seed protein, binds insulin in vitro and reduces plasma glucose levels of hyperglycemic rats; the effect of the oral administration of conglutin γ on the glycemic levels of rats subjected to glucose overloading was a statistically significant reduction in glycemia comparable to that of metformin, well-known glucose lowering drug. These findings represent the first molecular evidence of the possible use of a legume protein in the control of glycemia (Chiara et al., 2004).

The use of lupin total extract as hypoglycemia was described by Horvath, who proposed it as a substitute for insulin in mild to medium diabetes mellitus.

Clementi and Torrisi identified the hypoglycemizing active ingredient in the alkaloid lupanin, whose effect was however transient (Woldemichael, 2002).

Figure 21: Alkaloid in water

Figure 22: Terpene in ethanol

Figure 23: Alkaloid in ether

Figure 24: Alkaloid in ethanol
**T. foenum-graecum**

**Botanical classification**

**Distribution**

Fenugreek is a native of South Eastern Europe and West Asia. In India, fenugreek is grown in about 0.30 lakh ha producing annually about 30,000 tonnes of seeds (Kumar et al., 1997).
Phytochemical content
Seeds contain sapogenins-diosgenin, its 25-epimer (yamogenin), tigogenin, gitogenin, yuccagenin, 25-2-spirosta-3-5-diene, and its b-epimer. Seeds also contain a C27-steroidal sapogenin-peptide ester-fenugreekine. Seeds, in addition, contain 4-hydroxyleucine and saponins-fenugrins A-E: Two furostanol glycoxides-trigonelloxide C and

Figure 31: Alkaloid in ether

Figure 32: Alkaloid in ethanol

Figure 33: Alkaloid in water

Figure 34: Glycosides in water

Figure 35: Flavonoid in water

Figure 36: Resin in ethanol
(255)-22-O-methyl-52-firostan-3b,22,26,triol-3-O-a-rhamnopyrans yl (1-2) C-b-D-glucopyranosyl (1-3)-b Dglucopyranoxide-26-O-b-D-glucopyranoxide. Other chemical constituents are sterols-b-sitosterol
and cholesterol, flavone C glycosides-vitexin, isovitexin, vitexin-2”-O-P-coumarate, and vicenin-2.

**Traditional uses**

Seeds are bitter, mucilaginous, aromatic, carminative, tonic, diuretic, thermogenic, galactagogue, astringent, emollient, aphrodisiac, antirheumatic, CNS depressant, and anti-implantation. Fenugreekine is hypoglycaemic, diuretic, hypotensive, cardiotonic, and antiphlogistic. It showed 80% inhibition of vaccinia virus (Jouy *et al*., 1998).
Fenugreek contains sotolon, trigonelline, and 4-hydroxyisoleucine, compounds that are thought to be the active components of it. 4-hydroxyisoleucine may stimulate the secretion of insulin, which is why fenugreek may theoretically lower blood sugar. However, it is important to know that there is not enough scientific evidence to show that fenugreek is indeed effective for these uses.

Fenugreek may also contain “blood-thinning” compounds known as coumarins, but it is not known if these compounds are present in high enough quantities to actually make a difference in humans. The herb may also stimulate the uterus, heart, and intestines. However, it is important to know that there is not sufficient scientific evidence to show that fenugreek is effective for these uses (Riyaz, 2010).

*T. foenum-graecum* leaves also can be used as antidiabetic control, the aqueous extract of *T. foenum-graecum* leaf when given to both normal and alloxan-diabetic rats, a significant reduction of blood glucose concentration was noticed. On the other hand, the ethanolic extract of *T. foenum-graecum* leaf produced no reduction in blood glucose concentration in normal rats but intraperitoneal administration of 0.8 g/kg of the ethanolic leaf extract to diabetic rats produced a significant reduction of blood glucose concentration (*P* < 0.02) at 2 and 24 h only (Abdel-Barry et al., 1998).

Fenugreek seeds (*T. foenum-graecum*), a commonly used condiment in Indian homes, were evaluated for hypoglycemic property. In a metabolic study, 15 non-insulin dependent diabetic patients were given randomly, in a cross over design, diets with or without 100 g of defatted fenugreek seed powder, each for 10 days. Incorporation of fenugreek produced a significant fall in fasting blood glucose levels and an improvement in glucose tolerance test. Insulin responses were significantly reduced (Sharma et al., 1995).

25 g seeds of plant constitute a single dose and this dose is used daily for 21-days with water. It is one of efficient treatment to reduced blood glucose level among diabetics (Mushtaq et al., 2009). The leaves and seeds are used to treat diabetes in ayurvedic and other traditional medical systems. The most studied active ingredient is 4-hydroxyisoleucine, which increases pancreatic insulinsecretion and inhibits sucrose-D-glucosidase and –amylase (Amin et al., 1987).

**MATERIALS AND METHOD**

**Checklist**

Information in the list of plants recorded to control blood glucose is collected from available
references these references are:
• Medicinal plants of North Africa (Boulos, 1983).
• Medicinal and Aromatic and poisons Plants in Arab World (Saad et al., 1988).
• Medicinal plants of Sudan (El-Gazali et al., 1995).
• Medicinal plants of Sudan (El-Gazali et al., 1997).
• Medicinal plants of North Kordofan (El-Gazali et al., 2003).
• Medicinal and Aromatic plants traded in Khartoum State (El-Gazali et al., 1997).

Phytochemical screening
Phytochemical screening includes Test tubes, flasks, beakers, rack, water bath, bottles, pipettes, drops, D.W, H₂SO₄, 36% HCl, picric acid, Fehling’s reagents 1, 2, 50% ethanol, 50% KOH, 1% FeCl₃, 1% CH₃COOH, potassium hexacyanoferrate, biuret reagent.

Plant material
Dry seeds of B. rufescens were collected from Khartoum botanical garden, S. alexandrina collected from south omderman (Al-oshara Khartoum state), and C. aritenium, L. albus, and T. foenum-graecum were collected from Khartoum market (Khartoum state). Dry seeds were collected then were crushed in mortor and kept in clean bottles in laboratory [Figures 16-18].

The plants used in this study were
• B. rufescens
• S. alexandrina
• C. aritenium
• L. albus
• T. foenum-graecum.

Extraction procedure
Qualitative analysis of the chemical constituents the method used is that described by Alkofahi et al. (1997).
About 25 g of the dry crushed seeds plant sample were extracted using petroleum ether = % (b.p.40–45°C) in a Soxhlet apparatus for about 1½ h. About 25 g of the dry crushed seeds plant sample were extracted using distilled water (aqueous extracts) in room temperature for about 24 h. The extracts were put in dry clean beakers then closed strongly by foil and saved in 26°C. These extracts petroleum ether, ethanol, and aqueous extracts were used for the following tests.

Identification of protein
ML of the extract were talked then put in test tubes and biuret reagent was added. A violet color denotes the presence of protein.

Identification of basic alkaloids
The identification was carried out on the residue obtained by 10 ml of plant extract was acidified with 36% HCl and was tested by adding some drops of picric acid extract. Yellow precipitate refers to alkaloids.

Identification of basic glycosides
Glycosides detection: Two parts of Fehling’s reagent were mixed with plant extract, and left in a boiling water bath for 10 min. The appearance of red color indicates the presence of glycosides.

Identification of flavonoids
About 10 ml of 50% ethanol was added to 10 ml 50% KOH then this solution was mixed with equal volumes of plant extract. Yellow color refers to the presence of flavonoids.

Identification of tannin
About 10 ml from plant extract was divided into two equal parts and then drops of 1% CH₃COOH were added to the first part. The appearance of white Pillete means the presence of tannins. To the second part, drops of 1% FeCl₃ were added. Formation of green bluish color refers to the presence of tannins.

Identification of saponin
About 5 ml of plant extract was shaken well for half a minute and then left in a vertical position for 15 min. The appearance of foam indicates the presence of saponin.
Identification of resin
About 10 ml of acidified D.W. with 36% HCl was added to 10 ml of plant extract. If turbidity appears, it refers to the presence of resins.

Identification of phenol
About 3 ml of plant extract was added to 2 ml of 1.0M potassium hexacyanoferrate and 2 ml of 0.5M FeCl₃. The appearance of green bluish color indicates the presence of phenols.

Identification of terpenes (Salkowski test)
To 2 ml of extract were mixed with 2 ml of chloroform and concentrated sulfuric acid (3 ml) was carefully added to form a layer, a reddish brown color indicates to presence of terpenes.

Checklist
Information of literature survey of plants recorded to control glucose level in blood was presented in the form of a checklist. Result of this part [Table 1] includes the chemical constitutes and remediation of disorders other than diabetes. 48 plants species are recorded; they belong to 26 families. The common recorded family to possess wide knows the use for glucose regulation as shown from the list is Fabaceae/Leguminosae. It includes seven plants species, followed by the family Asteraceae/Compositae from which eight species recorded. Cucurbitaceae scone in the third position five species is presented from it.

Phytochemical screening of plants used in this study
Phytochemical results are shown in Tables 2-6. Key words:
• (++): Present in high concentration
• (+): Present in low concentration
• (−): Absent.

B. rufescens
B. rufescens represented alkaloid in all extracts with different concentration, as shown in Table 2 and [Figures 19-21] the lowest concentration appears in water extract. Terpene observed only in the ethanol extract [Figure 22].

S. alexandrina
S. alexandrina represented the different phytochemicals in the variable extracts as shown in Table 2 and Figures 23-30. Alkaloids are present in ether (higher Figure 23) and ethanol extracts. Glycoside: Represented in water and ether extracts (both in low concentrations). Flavonoid: represented in ether and ethanol extracts. Saponin and terpene are present only in ethanol extract. Tannin is only present in ether extract.

C. arietinum
As shown in Table 3 and Figures 31-38, C. arietinum represented alkaloid in all extract (higher in ether, Figure 31). Glycoside and flavonoid presented in water and ether extracts. Resin presented strongly in ethanol extract [Figure 36] weakly in water extract [Figure 37]. Terpene presents in ethanol extract only. Protein appears only in ether extract.

L. albus
L. albus: Alkaloids presented in all extract with higher concentration in ether extract [Figure 39], glycosides present in water and ethanol extract with different concentrations, flavonoid presented in water and ether extract (higher: Figure 40), saponin presented in all extract, terpene also presented in all extract (lower in water Figure 41), and resins presented in water and ethanol extract [Table 4].

T. foenum-graecum
T. foenum-graecum: Alkaloid presented in all extract (lower in ethanol extract, Figure 42), glycoside presented in ethanol extract. Flavonoid presented in water extract, saponin presented in water extract, resin presented in water (lower, Figure 43) and ethanol extract (higher, Figure 44). Terpene presented in all extract (lower in water, Figure 45). Protein is in ethanol extract only.

DISCUSSION

Alkaloid
The five species used in this study are from the same family (Fabaceae) presented with different concentration.
In B. rufescens, the presences of alkaloids in all extracts agree with the findings of El Ghazali et al. (1998). In S. alexandrina presented in ether and
ethanol but higher in ether extract and not presented in water extract, in *C. arietinum* and *L. albus* (similar to El Ghazali *et al.*, 1998 and Botonical.com, 2011) *L. albus* contain alkaloids, presented in all extract with higher concentration in ether, in *T. foenum-graecum* presented in all extract but low in ethanol.

**Glycosides**

In *B. rufescens* not presented (not similar to Hassan *et al.*, 2008) *B. rufescens* contain glycosides [cardiac]), in *S. alexandrina* low concentration in water and ether extract (similar to Global herbal supplies. 2009 *S. alexandrina* contain glycosides), in *C. arietinum* presented in low concentration in water extract, in *L. albus* presented in water and higher concentration in ethanol extract (similar to El Ghazali *et al.*, 1998 and Botonical.com, 2011 *L. albus* contain alkaloids, presented in all extract with higher concentration in ether, in *T. foenum-graecum* presented in all extract but low in ethanol similar to (Jouy *et al.*, 1998, seeds of *T. foenum-graecum* contain glycosides).

**Flavonoids**

In *B. rufescens* not presented (similar to El Ghazali *et al.*, 1998 *B. rufescens* contain flavonoid) in *S. alexandrina* presented higher in ether and ethanol extract similar to (Husain *et al.*, 1992) *S. alexandrina* contain flavonoid, in *C. arietinum* and *L. albus* presented higher in ether and water extract, in *T. foenum-graecum* presented higher concentration in water extract (similar to Jouy *et al.*, 1998, seeds of *T. foenum-graecum* contain flavonoids).

**Phenol**

All species are not presented phenol.

**Saponin**

*B. rufescens* not presented saponin (Hassan *et al.*, 2008) *B. rufescens* contain saponin, in *S. alexandrina* presented only in ethanol extract (higher), in *C. arietinum* not presented, in *L. albus* presented strongly in all extract, in *T. foenum-graecum* presented in water extract (lower concentration) (similar to Jouy *et al.*, 1998) seeds of *T. foenum-graecum* contain saponin.

**Tannin**

*Bauhinia rufescens* not presented tannin (not similar to Hassan, *et al.*, 2008) which contain tannin), in *S. alexandrina* presented strongly in ether extract, in *C. arietinum, L. albus*, and *T. foenum-graecum* not presented.

**Resins**

*B. rufescens* and *S. alexandrina* not presented Resin, in *C. arietinum* and *L. albus T. foenum-graecum* and presented in water (lower) and higher concentration in ethanol extract.

**Terpenes**

*B. rufescens* (similar to Hassan *et al.*, 2008, *B. rufescens* contain terpene), *S. Alexandrina*, and *C. arietinum* presented terpene strongly in ethanol extract, in *L. albus* and *T. foenum-graecum* are present in water (lower) and higher concentration in ether and ethanol extract.

**Protein**

Detected in *B. rufescens* and *S. alexandrina* are not present, in *C. arietinum* present in ether extract (this is similar to Azila, 2007 contain about 20% protein), *L. albus* and *T. foenum-graecum* presented with a higher concentration in ether extract. *Senna alexandrina* has inhibitory and activator enzymes (alpha-amylase and alpha-glycosidase) which can activate the secretion of islets Langerhans (Nana, 2010). It is reported by NIDDK (2010) that diabetes medications have a side effect such as low blood sugar weight gain nausea; they can even cause death. Diabetes.com (2007) estimated that more than 2.1 million people are injured, experiencing adverse drug reaction, and more than 105.000 people die every year, due to the prescription drugs. Since diabetes medication has side effects, the world goes through another types of treatment to reduce these effects, so they use traditional medicine. Different plant families such as Asteraceae (*A. maritima*) and Asclepiadiaceae (*S. argel*), Alliaceae/Liliaceae (*A. cepa*) and Fabaceae/ Leguminosae (*L. albus*) are commonly used as diabetes medications. There is no evidence which phytochemical is effective in the decreasing glucose level in the blood.
and its regulation, but from the literature survey, the effective components may be proteins and alkaloids. It is clear from this small work that plants can play an important role to help in the regulation of blood sugar level and to minimize the side effect of diabetes medications. In Sudan, most of the reported plants are available in the natural flora or can easily be cultivated.

More studied are must concentrate on:
- More literature survey and collection of ethnobotanical data on the studied subject.
- Detailed phytochemical screening of the components of the studied plants.
- The correlation between the studied plant’s constituents and the regulation of blood sugar level.
- Detection of protein with more advanced technique.

REFERENCES


Websites:
Site (3): www.NDDK.com
Site (6): www.Wikispecies.com
Site (7): Global Herbal Supplies.com
Site (9): www.Medicinal plants.com
Site(10): www.Botonical.com
00911713050 allaawia@hotmail.com
-----------------------------gmail.com

قائمة للنباتات التي تعمل على تنظيم مستوى الجلكوز في الدم والتحليل الكيميائي لخمسة أنواع من البقوليات

ملخص البحث

في الجزء الأول من هذه الدراسة تم عمل مسح للنباتات التي ذكرت أنها تعمل على خفض مستوى السكر في الدم مع ذكر مكوناتها الكيميائية والامراض التي تستخدم لعلاجها غير مرض السكري. ثمانية وخمسون نوعا من النباتات المذكورة في الجدول تم جمعها من المراجع المتوفرة في الجزء الثاني من الدراسة أجري تحليل كيميائي لذات النباتات المختارة من العائلة البقولية وهي: الكول كول – السنا – الحمص – الترمس و الحلبة وهذال النباتات استخلصت في الماء والايثانول والايثر البترول.

الكل كول: ظهر اعلى تركيز في نبات الحلبة و على تركيزات مختلفة من المواد الفعالة وهي: القليودات: ظهرت في مستخلصات النباتات لكنها أكثر تركيزا في نبات الحلبة والكل كول.

الجيلوكويدات: كانت أكثر تركيزا في نباتي السنا والترمس.

الفلافونيات: ظهرت في كل المستخلصات لكنها أكثر تركيزا في الكرز والكل كول والترمس.

الفينولات: لم تظهر في جميع النباتات.

الصابونين: ظهر على تركيز في الترمس.

التيتريدين: ظهر في السنا.

البروتينات والفلقيوديات: ظهر في كل النباتات و كان أعلى تركيز في الحلبة.

البروتينات: لم تظهر في كل النباتات، تركز في الترمس والحمص والحلبة والترمس والفلقيوديات والمركبات الأساسية التي عرفت بخفض مستوي السكر في الدم.