ISSN 2521 – 0408

AGRICULTURAL EXTENSION JOURNAL

Available Online at www.aextj.com
**Agricultural Extension Journal 2019; 3(1):38-57**

**RESEARCH ARTICLE**

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

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**Received: 25-10-2018; Revised: 25-11-2018; Accepted: 10-02-2019**

## 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]

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***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

**Figure 1:** Saponin in ethanol

**Figure 2:** Alkaloid in ethanol

**Figure 3:** Alkaloid in water

**Figure 4:** Flavonoid in water

**Figure 5:** Saponin in ether

**Figure 6:** Saponin in water

**Figure 7:** Resin in ethanol

**Figure 8:** Resin in water

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).

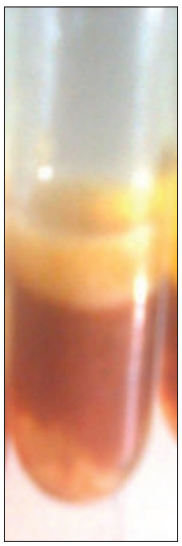

**Figure 9:** Terpene in ether

**Figure 10:** Terpene in ethanol

**Figure 11:** Protein in ether

*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]

**Figure 12:** Alkaloid in ether

**Figure 13:** Alkaloid in water

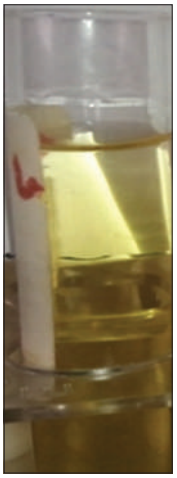

**Figure 14:** Flavonoid in water

*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 gives to diabetic patient vary according to diabetes type: patients who have type 1 must take insulin pumping or

**Figure 15:** Saponin in water

**Figure 16:** Terpene in ether

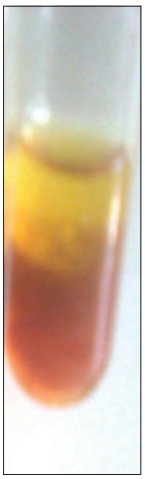

**Figure 17:** Terpene in ethanol

**Figure 18:** Protein in ether

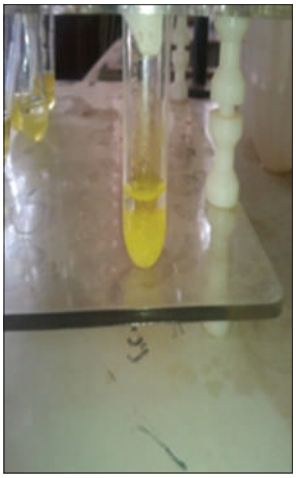

**Figure 19:** Alkaloid in ether

**Figure 20:** Alkaloid in ethanol

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 Asclepiadiaceae (*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 desytnre, 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.[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*.[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.[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.[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 β-sitosterol, lupeol, and a flavanone glycoside-5, 7-dimethoxy flavanone 4-O-α-Lrhamnopyranoside- β-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, antileprotic, and antirheumatic. 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 ophthalmic 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.[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.[35] Furthermore, cassia fistula reported as antidiabetic.[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.[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.[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

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

*(Contd...)*

**Table 1:** *Continued*

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

**Table 2:** Qualitative analysis of *Bauhinia rufescens*

| Name of test | Water extract | Ether extract | Ethanol extract |
|---|---|---|---|
| Alkaloid | + | ++ | ++ |
| Glycoside | – | – | – |
| Flavonoid | – | – | – |
| Phenol | – | – | – |
| Saponin | – | – | – |
| Tannin | – | – | – |
| Resin | – | – | – |
| Terpene | – | – | ++ |
| Protein | – | – | – |

**Table 3:** Qualitative analysis of *Senna alexandrina*

| Name of test | Water extract | Ether extract | Ethanol extract |
|---|---|---|---|
| Alkaloid | – | ++ | + |
| Glycoside | + | + | – |
| Flavonoid | – | ++ | ++ |
| Phenol | – | – | – |
| Saponin | – | – | ++ |
| Tannin | – | ++ | – |
| Resin | – | – | – |
| Terpene | – | – | ++ |
| Protein | – | – | – |

**Table 4:** Qualitative analysis of *Cicer arietinum*

| Name of test | Water extract | Ether extract | Ethanol extract |
|---|---|---|---|
| Alkaloid | + | ++ | + |
| Glycoside | ++ | – | – |
| Flavonoid | ++ | ++ | – |
| Phenol | – | – | – |
| Saponin | – | – | – |
| Tannin | – | – | – |
| Resin | + | – | ++ |
| Terpene | – | – | ++ |
| Protein | – | ++ | – |

*Traditional uses*

Burning sensation, hepatomegali, stomatitis, bronchitis, inflammations, and skin diseases, food and diabetes (Medicinal plants.com.2011).

*Cicer* species seed is used as a mixture with another plant to control blood glucose **(**Mushtaq *et al*., 2009).

*C. arietinum* is mixed with another species of legume which is used in the dietary management of diabetes (Khan *et al.*, 2009).

Plasma glucose level can be decreased by *C. arietinum* (bengal gram dal) 82% (Jang *et al.,* 1981).

**Table 5:** Qualitative analysis of *Lupinus albus*

| Name of test | Water extract | Ether extract | Ethanol extract |
|---|---|---|---|
| Alkaloid | + | ++ | + |
| Glycoside | + | – | ++ |
| Flavonoid | ++ | ++ | – |
| Phenol | – | – | – |
| Saponin | ++ | ++ | ++ |
| Tannin | – | – | – |
| Resin | + | – | ++ |
| Terpene | + | ++ | ++ |
| Protein | – | ++ | – |

**Table 6:** Qualitative analysis of *Trigonella foenum-graecum*

| Name of test | Water extract | Ether extract | Ethanol extract |
|---|---|---|---|
| Alkaloid | ++ | ++ | + |
| Glycoside | – | – | ++ |
| Flavonoid | ++ | – | – |
| Phenol | – | – | – |
| Saponin | + | – | – |
| Tannin | – | – | – |
| Resin | + | – | ++ |
| Terpene | + | ++ | ++ |
| Protein | – | ++ | – |

*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, flattened 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*[18]

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).

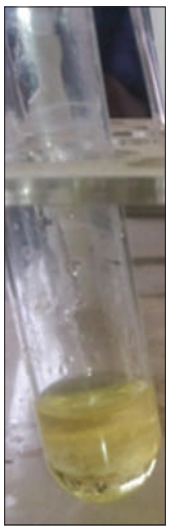

**Figure 21:** Alkaloid in water

**Figure 22:** Terpene in ethanol

**Figure 23:** Alkaloid in ether

**Figure 24:** Alkaloid in ethanol

**Figure 25:** Glycosides in water

**Figure 26:** Glycosides in ether

**Figure 27:** Flavonoid in ether

***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).

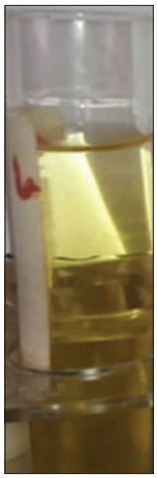

**Figure 28:** Flavonoid in ethanol

**Figure 29:** Saponin in ethanol

**Figure 30:** Terpene in ethanol

**Botanical description**

*T. foenum-graecum* Linn. belongs to family, Fabaceae. It is an annual herb, 30–60 cm in height, leaves are light green, pinnately trifoliate, and leaflets toothed, flowers are white or yellowish white, papilionaceous, and axillary. Fruits are legumes, 5–7.5 cm long, narrow, curved, tapering with a slender point and containing 10–20 deeply furrowed seeds per pod (Kumar *et al.*, 1997; Warrier *et al.*, 1995).

**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

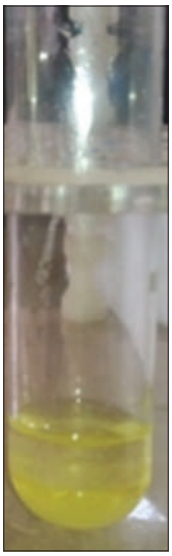

**Figure 31:** Alkaloid in ether

**Figure 32:** Alkaloid in ethanol

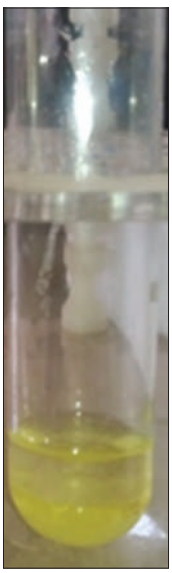

**Figure 33:** Alkaloid in water

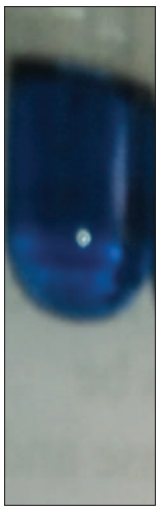

**Figure 34:** Glycosides in water

**Figure 35:** Flavonoid in water

**Figure 36:** Resin in ethanol

(255)-22-O-methyl-52-firostan-3b,22,26,triol-3-O-a-rhamnopyrans syl (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.

**Figure 37:** Resin in water

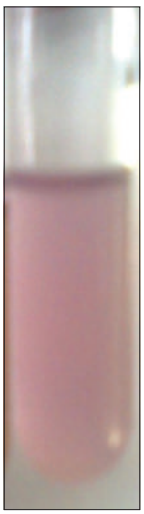

**Figure 38:** Protein in ether

**Figure 39:** Alkaloid in ether

**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).

**Figure 40:** Flavonoid in ether

**Figure 41:** Terpene in water

**Figure 42:** Alkaloid in ethanol

**Figure 43:** Resin in water↑ (left)

**Figure 44:** Resin in ethanol

**Figure 45:** Terpene in water

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. The seeds also contain fiber and pectin, a complex carbohydrate, both of which may slow down the digestive tract, which can help 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 medicalsystems. The most studied active ingredient is 4-hydroxyisoleucine, which increases pancreatic insulin secretion 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, $H_2SO_4$, 36% HCl, picric acid, Fehling's reagents 1, 2, 50% ethanol, 50% KOH, 1% FeCl3, 1% $CH_3COOH$, 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. f oenum-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 1 h.

About 25 grams of the dry crushed seeds plant sample were extracted using ethanol =70% (b.p.406°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% $CH_3COOH$ were added to the first part. The appearance of white Pillete means the presence of tannins. To the second part, drops of 1% $FeCl_3$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 $FeCl_3$. The appearance of green bluish color indicates the presence of phenols.

*Identification of terpenes (Salkowski test)*

To 2 ml of extract ware 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 glycosides), in *T. foenum-graecum* presented strongly in ethanol extract 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. aretinum*, *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.[46] S*enna 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.

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قائمة للنباتات التي تعمل علي تنظيم مستوي

الجلكوز في الدم

والتحليل الكيميائي لخمسة أنواع من البقوليات

ملخص البحث

في الجزء الاول من هذه الدراسة تم عمل مسح للنباتات التي ذكرت انها تعمل علي خفض مستوي 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 اجري تحليل كيميائي لبذورالنباتات المختارة من العائلة البقولية وهي:

الكول كول – السنا – الحمص – الترمس و الحلبةوهذه النباتات استخلصت في الماء والايثانول والايثر البترول.

واظهرت الاختبارات الكيميائية تراكيز مختلفة من المواد الفعالة وهي:

القلويدات: ظهرت في مستخلصات النباتات لكنها اكثر تركيزا في نبات الحلبة والكل كول.

الجليكوسيدات: كانت اكثر تركيزا في نباتي السنا والترمس.

الفلافونيدات كظهرت في كل المستخلصات لكنه اكثر تركيزا في الكل كول والسنا والترمس.

الفينولات: لم تظهر في جميع النباتات

الصابونين: ظهر اعلي تركيز في الترمس.

التانين: ظهر في السنا.

التيربين: ظهر في كل النباتات وكان اعلي تركيز في الحلبة

البروتين: لم تظهر كل الباتات تراكيز من البروتين وظهر في الترمس والحمص والحلبة.

البروتينات والقلويدات المركبات الاساسية التي عرفت بخفضها للمستوي السكر في الدم.