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The efficacy of Ayurvedic single and compound drugs to control diabetes mellitus

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University of Rajshahi

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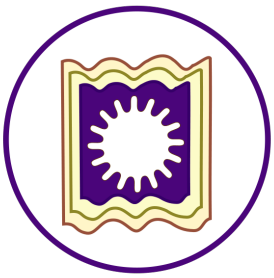

THESIS

SUBMITTED TO THE UNIVERSITY OF RAJSHAHI

IN THE FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF PHILOSOPY

IN BOTANY.

SUBMITED BY

MD. TOYEBUR RAHAMAN

DEPARTMENT OF BOTANY
UNIVERSITY OF RAJSHAHI
RAJSHAHI-6205
BANGLADESH

JUNE 2013

DEDICATION

Dedicated
To My
Beloved Parents

DECLARATION

This dissertation entitled “The efficacy of Ayurvedic single and compound drugs to control diabetes mellitus” submitted by Md. Toyebur Rahman in the fulfillment of the requirements for the degree of Master of Philosopy, under University of Rajshahi. The study was carried out at the outdoor department of my Personal Chamber, Mirpur, Dhaka during the session 2006-2007.

Md. Toyebur Rahaman

Candidate

M. Phil Thesis

THE EFFICACY OF AYURVEDIC SINGLE AND COMPOUND DRUGS TO CONTROL DIABETES MELLITUS

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June, 2013 Md. Toyebur Rahaman

ABSTRACT

Ayurvedic medicine could be an effective measure in the treatment of diabetes mellitus. An interventional study was carried out in the private chamber of the researcher at Mirpur thana of Dhaka district to assess the efficacy of Ayurvedic medicine on this disease.

A semi-structured questionnaire was administrated upon to perform the experiment, 450 male subjects within 40 to 65 years aged were randomly divided into 9 equal groups. Moreover, 450 female subjects within 40 to 65 years aged were also randomly divided into 9 equal groups. one group was kept as normal control group (A) and another 1 (one) group was kept as diabetic control group (B) and in other 6 (six) groups – group (C), group (D), group (E), group (F), group (G), group (H) were treated with single Ayurvedic drugs and group (I) was treated with synthetic drugs. The study revealed that in male, after three months of treatment using single medication, the result of RBS in Control group had 11.32 mmol/L, Mathi group had 8.88 mmol/L, Jam beez group had 8.93 mmol/L, Corolla group had 8.96 mmol/L, Bot group had 9.19 mmol/L, Neem group had 9.23 mmol/L, Tejpata group had 9.40 mmol/L and Synthetic group had 8.75 mmol/L. Moreover, in female, after three months treatment using single medication, the RBS of group-A had 6.70 mmol/L, group-B had 11.33 mmol/L, group-C had 8.98 mmol/L, group-D had 9.03 mmol/L, group-E had 9.09 mmol/L, group-F had 9.19 mmol/L, group-G had 9.28 mmol/L, group-H had 9.47 mmol/L, group-I had 8.90 mmol/L. On the other hand, after three months of treatment with combine Ayurvedic drug among male subjects, the RBS of group-A had 5.58 mmol/L, group-B had 9.23 mmol/L, group-C had 8.73 mmol/L and group-D had 8.23 mmol/L. Moreover, after three months treatment with combine Ayurvedic drug among female subjects, the RBS of group-A had 5.58 mmol/L, group-B had 9.23 mmol/L, group-C had 8.69 mmol/L and group-D had 8.13 mmol/L. All drugs had better efficacy and complication was reduced by the treatment of Ayurvedic medicine.

The findings indicated compound Ayurvedic medicine was more effective than single Ayurvedic medicine .so the patients can use proposed compound Ayurvedic medicine to control diabetes mellitus.

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1. INTRODUCTION

1.1. INTRODUCTION

Diabetes mellitus is a common and very prevalent disease affecting human being of both developed and developing countries. It is estimated that 25% of the world population is affected by this disease. Diabetes mellitus is caused by the abnormality of carbohydrate metabolism which is linked to low blood insulin level or insensitivity of target organs to insulin (Maiti *et al*., 2004). Despite considerable progress in the treatment of diabetes by oral hypoglycemic agents, search for newer drugs continues because the existing synthetic drugs have several limitations. The herbal drugs with antidiabetic activity are yet to be commercially formulated as modern medicines, even though they have been acclaimed for their therapeutic properties in the traditional systems of medicine (Wadkar *et al*., 2008). Plants may provide a potential source of hypoglycemic drugs because many plants and plant derived compounds have been used in the treatment of diabetes. Many medicinal plants have been investigated for their beneficial use in different types of diabetes and reports occur in numerous scientific journals. Ayurveda and other traditional medicinal system for the treatment of diabetes describe a number of plants used as herbal drugs. Hence, they play an important role as alternative medicine due to less side effects and low cost. The active principles present in medicinal plants have been reported to possess pancreatic beta cells re-generating, insulin releasing and fighting the problem of insulin resistance (Welihinda *et al*., 1982). Hyperglycemia is involved in the etiology of development of diabetic complications. Hypoglycemic herbs increase insulin secretion, enhance glucose uptake by adipose or muscle

tissues and inhibit glucose absorption from intestine and glucose production from liver (Hongxiang *et al.,* 2009) Insulin and oral hypoglycemic agents like sulphonylureas and biguanides are still the major players in the management but there is quest for the development of more effective anti-diabetic agents.

1.1.1. Diabetes and its Impact on Human Health and Economy

Diabetes mellitus is a chronic condition characterized by major derangements in glucose metabolism and abnormalities in fat and protein metabolism. There are several forms of diabetes and spontaneous diabetes is the major form in the West, whereas malnutrition-related diabetes is a major form in Africa and Asia. Spontaneous diabetes is classified into Type 1 and Type 2 diabetes. Type 1 diabetes [insulin-dependent diabetes mellitus (IDDM)] is inherited and usually occurs in early life. Type 1 diabetics produce very little insulin or none at all, and therefore, glucose accumulates in the blood serum unless insulin is supplied. Type 2 diabetes (non-insulin dependent diabetes mellitus, NIDDM) is referred to as adult onset diabetes and accounts for over 90 to 95% of the diabetics in the U.S. (NDIC, 2003). An estimated 143 million people suffer from diabetes worldwide and the number is growing rapidly (Agrawal, 2003). In the USA, about 18.2 million or 6.3% of the population are diabetic (ADA, 2005). Minority ethnic groups including, Africa Americans in general and particularly native Americans have alarmingly higher incidence of Type 2 diabetes than the non-Hispanic white population. Approximately 2.8 million or 13% of Africa Americans have been diagnosed with diabetes (NDIC, 2003). The diabetes mortality rate among Africa Americans is approximately twice that among non-Hispanic whites. About 73% of adults with diabetes have high blood pressure. Diabetes is the leading cause of blindness among adults aged 20 to 74 years.

Diabetic retinopathy (deterioration of blood vessels in the eye) is the cause of 12,000 to 24,000 new cases of blindness each year and it has been estimated to be 40 to 50% higher among African Americans than white Americans (Harris *et al*., 1998). Diabetes is the leading cause of end-stage renal disease (ESRD) that has been shown to be about four times greater among African Americans than non-Hispanic white Americans.

1.1.2 Plant Species with Antidiabetic Properties

Plant-based medicinal products have been known to man since ancient times, (Subbulakshmi and Naik, 2001). Plants have been the primary source of drugs and many of the currently available drugs have been directly or indirectly derived from plants. For example, the popular hypoglycemic drug glucophage (metformin) is derived from *Galega officinalis* (Grover *et al.,* 2002). About 800 plant species have been reported to possess antidiabetic properties (Alarcon-Aguilara *et al.,* 1998). Awide array of plant derived principles belonging to compounds mainly alkaloids, glycosides, galactomannan gum, polysaccharides, hypoglycans, peptidoglycans, guanidine, steroids, glycopeptides, and terpenoids have demonstrated bioactivity against hyperglycemia (Ivorra *et al.,* 1988; Maries and Farnsworth, 1995). Several plant species have been used for prevention or management of diabetes by the Native Americans (Johnston, 1987), Chinese (Foster, 1993; Vuksan, 2000), South Americans and Asian Indians (Subbalakshmi and Naik, 2001; Grover *et al.,* 2002). Among plants used for managing diabetes by the native Americans, Thimbleberry (*Rubus parviflorus*) and Serviceberry (*Amelanchier alnifolia*) also called Saskatoon Berry or Okinoki have been used by the Blackfeet Tribe for alleviating diabetes (Johnston, 1987) and continue to be used to this day. Considering this the Research aims to validate the

antidiabetic properties and identify the bioactive compound (s) associated with such properties was carried out. McCune and Johns, (2002) evaluated 35 plant species traditionally used by indigenous people of the boreal forest in Canada for treating diabetes or its complications. Among 45 medicinal plants and their products (active natural principles and crude extracts) that have been mentioned in the Asian Indian traditional system of medicine called 'Ayurveda', *Allium cepa, Allium sativum, Aloe vera, Cajanus cajan, Coccinia indica, Caesalpinia bonducella, Eugenia jambolana, Ficus bengalenesis, Gymnema sylvestre, Momordica charantia, Murraya koeingii Ocimum sanctum syn. tenuit/arum, Pterocarpus marsupium, Swertia chirayita, Syzigium cumini, Tinospora cordifolia and Trigonella faenum-graecum* are considered the most effective and more extensively studied in relation to diabetes and its complications (Grover *et al.,* 2002). Extensive reviews on medicinal plants used to treat one or more complications of diabetes had been published (Subbulakshmi and Naik, 2001: Grover *et al*., 2002). In this research, only those species that had been validated for their hypoglycemic and/or ant hyperglycemic properties will be presented.

Table 1.1: List of anti-diabetic plants.

Sl. No.	Name of the Species	Family	Local Name	Therapeutic Use
1	*Abutilon indicum (L.) Sweet*	Malvaceae	Thutthi	Leaf extract used for treating diabetes.
2	*Aegle marmelos (Linn.) Corr. Serr.*	Rutaceae	Vilvamaram	Tender leaf (10 mL) mixed with 2-3 drops of honey given twice daily (evening and morning) on empty stomach to reduce blood sugar within 3-4 weeks
3	*Alternanthera sessilis (L.) R.Br. ex DC.*	Amaranth-aceae	Ponnagkanni-keerai	The whole plant of Alternanthera sessilis is used to treat diabetes
4	*Anacardium occidentale L.*	Anacardia-ceae	Munthiri	Leaf extract used for treating diabetes
5	*Andrographics paniculata (Burm.f.)*	Acanthaceae	Periyanangai	About 10 mL of leaf/root deoction given once aday for six months against both hyperglycaemia and gastric disorder.
6	*Azadirachta indica Adr. Juss,*	Meliaceae	Veppa maram	Seven tender leaves of the plant are prescribed daily to the person suffering from diabetes. six seeds of the plant made into a paste with 50 ml rice wash and 5 mL of ghee should be given after meal in case of long standing diabetes
7	*Bacopa monnieri (Linn.) Pennell*	Scrophulari-aceae	Neerpirambi	Leaf juice is used for treating diabetes.
8	*Boehaavia diffusa Linn.*	Nyctaginac-eae	Sattaranai	The raw leaf juice (10 mL) is used to reduce sugar in urine. The patient is also advised to take the leaves and tender branch tips as vegetables.

Sl. No.	Name of the Species	Family	Local Name	Therapeutic Use
9	*Butea monsperma (Lam.) Taub.*	Fabaceae	Kattuthee	The leaf extract (10 mL) is administered once a day fro 5-10 days on empty stomach. This reduces blood sugar and is also useful in glycosuria
10	*Carica papaya Linn.*	Caricaceae	Pappali	Green fruits are boiled and made into a paste and given with a pinch of common salt and jeera powder (*Cuminum cyminum*) for six months to cured diabetes
11	*Cassia auriculata Linn.*	Caesalpinia-ceae	Aavaram	Leaf juice (10 mL) mixed with 5g old jaggery given once daily for one month at early stage of the diabetes
12	*Cassia fistula L.*	Caesalpinio-ideae	Sarakkodrai	Pod extract of the plant is used for treating diabetes.
13	*Catharanthus roseus (Linn.) G. Don.*	Apocynaceae	Nithitakalyani	Fresh twig with two leaf buds is given daily for 7 days on empty stomach. During this administration, eating sugar containing food stuffs is strictly prohibited.
14	*Vinca rosea Linn*	Menisperm-aceae	Sutukattumalli	About 60 g of the rood is boiled in half a littre of water for 20-30 minutes in a closed vesseal. About 30-60mL of this preparation is given two or three times daily to correct the kidney disorder caused by diabetes.
15	*Cissampelos pareira Linn.*	Cucurbita-ceae	Ponmucuttai	Decoction of the plant twig along with flowers and young fruits given once daily for seven days for the treatment of sugar complaints.

Sl. No.	Name of the Species	Family	Local Name	Therapeutic Use
16	*Coccinia grandis (Linn.) Voigt.*	Convolvula-ceae	Kovai	The infusion of the whole plant, sweetened with jaggery of weight caused by diabetes
17	*Cressa cretica Linn.*	Cucurbita-ceae	Uppumarikol-unthu	Seeds (2g) made into paste with liquorice (*Glycyrrhiza glabra*) is given daily for 15 days to reduce the sugar level in blood. Those who suffer from diabetes and those who want to lose weight should be advised to consume unripen fruits.
18	*Cucumis sativus Linn.*	Zingiberaceae	Vellari	15-20 mL of fresh juice of the rhizome with equal amount of fresh juice of nelli (*Phyllanthus emblica*) given three times in a day for 15 days against glycosuria
19	*Curcuma longa Linn.*	Moraceae	Mancal	An infusion of the bark (10 g) mixed 5 g jaggery is an effective and specific medicine for diabetes. This should be given once daily for 10 15 days to reduce blood sugar. The laticiferous sap of this tree is also effective in controlling the diabetes. An increasing capacity of pancreatic cells.
20	*Ficus benghalensis Linn.*	Moraceae	Aalamaram	A paste (50g) made out of the boiled unripe fruit and equal quantity of fine rice, given with normal meal for 23 months to reduce the sugar level in urine.

Collected from (Kumar *et al.*, 2011)

1.2 ROLE OF MEDICINAL PLANTS IN THE TREATMENT OF DIABETES

The plant kingdom has become a target for the search of biologically active lead compounds by multinational drug companies. Many of these medicinal plants and herbs are also part of our diet as spices, vegetables and fruits. They are a potential source of many drugs used in modern medicine, for example, quinine, opium alkaloids, atropine, cardiac glycosides (digitalis) and the popular hypoglycemic drug glucophage (metformin), derived from *Galega officinalis* (Grover *et al.,* 2002). The effects of these plants may delay the development of diabetic complications and manage the metabolic abnormalities. The following traditional Indian medicinal plants are described chronologically *Allium cepa* Linn. (Family: Liliaceae), pyaj (Bangla); onion (common name). *Allium sativum* Linn. (Family: Alliaceae), Rahasun (Bangla); garlic (common name). *Aloe vera* (Linn.) Burm. (syn. *Aloe barbadensis* Miller) (Family: Aloaceae), ghee Greto kumari (Bangla); aloe (common name). *Azadirachta indica* A. Juss. (Family: Meliaceae), neem (Bangla); Indian lilac tree or neem (common name). *Gymnema sylvestre* R. Br. (Family: Ascelpiadaceae), gudmar (Bangla); periploca of the woods (common name). *Syzygium cumini* Linn. (syn. *Eugenia jambolana* (L.) (Family: Myrtaceae), jamun (Hindi); blackberry (English). *Pterocarpus marsupium* Roxb. (Family: Fabaceae), vijayasar (Hindi); Indian kino tree (English).

1.3 INTRODUCTION TO AYURVEDA

Ayurveda is considered by many scholars to be the oldest healing science. In Sanskrit, Ayurveda means "The Science of Life." Ayurvedic knowledge originated in India more than 5,000 years ago and is often called the "Mother of All Healing." It stems from the ancient Vedic culture and was taught for many thousands of years in an oral tradition

from accomplished masters to their disciples. Some of this knowledge was set to print a few thousand years ago, but much of it is inaccessible. The principles of many of the natural healing systems now familiar in the West have their roots in Ayurveda, including Homeopathy and Polarity Therapy (Vasant, 2003).

1.3.1 Ayurveda and Diabetes Mellitus

Diabetes mellitus (DM) is described in Ayurveda as *madhumeha kshaudrameha*, which literally means "excessive urine with sweet taste like honey," or *dhatupak janya vikriti*, which means a disease caused by a defective metabolism leading to derangement in body tissue (seven *dhatus*) transformation process. Historically, Ayurvedic texts have described 20 types of urinary disorders (*pramehas*) based on the predominant doses (10 *kaphaja*, 6 *pittaja* and 4 *vataja* urinary disorders) and physical characteristics of the urine (e.g., volume, color, odor, taste, sediments, solid particles, presence of seminal fluid, and mucus). The urine is discharged in excessive quantities and is generally turbid. DM is one of these pramehas that may occur in any of the three (vata, kapha or pitta) body constitutions (Mishra and Tarek, 2003). To examine the efficacy of Ayurvedic single and compound drugs to control diabetes mellitus the following single drugs and there combination formulation was taken into consideration.

1. *Trigonella foenum-graecum* (Mathi)
2. *Syzygium cumini* (Jam beez)
3. *Momordica charantia* (Korolla)
4. *Ficus benghalensis* (Bot)
5. *Azadirachta indica* (Neem)
6. *Cinnamomum tamala* (Tejpata)

1.4 HYPOTHESIS

Ayurvedic medicine may cure the diabetes mellitus

1.5 OBJECTIVES

1.5.1 General Objectives

To find out the efficacy of Ayurvedic medicine to control the diabetes mellitus.

1.5.2 Specific Objectives

I. To find out the improvement of the disease conditions after receiving treatment.

II. To find out the importance of the disease conditions after receiving treatment.

2. LITERATURE REVIEW

2.1 LITERATURE REVIEW

Diabetes is a growing health concern worldwide and now emerging as an epidemic world over. The management of diabetes is still a major challenge. Thus there is great demand for research on natural products with anti-diabetic properties. Numerous studies have confirmed the benefits of medicinal plants with anti-hyperglycemic effects in the management of diabetes mellitus. In this review, we address the beneficial effects of selective medicinal plant species such as *Allium cepa*, *Allium sativum*, *Aloe vera*, *Azadirachta indica*, *Gymnema sylvestre*, *Syzygium cumini* and *Pterocarpus marsupium* and emphasize on the role of active biomolecules which possess anti-diabetic activity (Ayesha Noor *et al.,* 2013).

2.1.1 Active Hypoglycemic Constituents from Plants

This study was carried out to open the new horizon in the light of the evidence of the scientific basis. A wide and diverse range of plants have been reported in the literature to prevent and treat diabetes. Several phyto-chemicals, including alkaloids, flavonoids, glycosides, glycolipid, galactomannan, polysaccharides, peptidoglycan, hypoglycans, guanidine, steroids, carbohydrates, glycopeptides, terpenoids, amino acids, saponins, dietary fibres and inorganic ions affect various metabolic cascades, which directly or indirectly affect the level of glucose in the human body (Grover *et al.,* 2001). These have produced potent hypoglycemic, anti-hyperglycemic and glucose suppressive activities. The above effects achieved by either increase in serum insulin level or increase in the production of insulin from pancreatic β-cells, inhibit glucose absorption in the gut, stimulate glycogenesis in liver or increase glucose utilization

by the body (Grover *et al.,* 2001; Saxena *et al.,* 2004 and Gupta *et al.,* 2008). These compounds also exhibit their antioxidant, hypolipidemic, anticataract activities, restored enzymatic functions, repair and regeneration of pancreatic islets and alleviation of liver and renal damage.

A few traditional Indian anti-diabetic plants and their beneficial effects have been studied in various models of experimental diabetes like mice, rats and rabbits with the dosage of different plant parts; the period of study varied between 24 h and 45 days. Limited relevant clinical studies substantiate the anti-diabetic activities of these plants. Administration of sulphur-containing amino acids, namely S-methyl *Cysteine sulfoxide* (SMCS) and diallyl thiosulfinate isolated from the plants *Allium cepa* (Kumari *et al.,*1995) and *Allium sativun* (Saravanan *et al.,* 2010) to alloxan-induced diabetic rats activates the enzymes hexokinase, glucose-6-phosphatase, 3-hydroxy-3-methyl-glutaryl (HMG) Co-A reductase and lecithin-cholesterol acyltransferase (LCAT). S-allyl cysteine (SAC), a sulphur-containing amino acid derived from *A. sativum* may constitute an alternative to insulin as both long and short-term treatments with this compound manage the hyperglycemia that occurs in diabetic mode (Nasim *et al.,* 2009). To show the efficacy of Ayurvedic single and compound drugs to control Diabetes mellitus the following single drugs and there combination formulation was taken though there is more than 200 of anti diabetic plants.

1. *Trigonella foenum-graecum* (Mathi)
2. *Syzygium cumini* (Jam beez)
3. *Momordica charantia* (Korolla)
4. *Ficus benghalensis* (Bot)
5. *Azadirachta indica* (Neem)
6. *Cinnamomum tamala* (Tejpata)

2.1.1.1 *Trigonella foenum-graecum* (Mathi)

Taxonomic position of the *Trigonella foenum-graecum* (Mathi)

Kingdom : Plantae

Division : Magnoliophyta,

Class : Magnoliopsida.

Order : Fabales

Family : Fabaceae,

Genus : *Trigonella* L.

Species : *T. foenum-graecum*

Fenugreek (*Trigonella foenum-graecum*) is a popular herb grown for its tender plants and seed for culinary uses in India. It has proven hypoglycemic activity in experimental animals (Grover *et al.,* 2002; Vats *et al.,* 2002). A dose-response relationship between *T. foenum-graecum* seed and blood glucose levels of alloxan-diabetic rats was reported by (Vats *et al.,* 2002). In a study published by (Vats *et al.,* 2003), administration of *T. foenum-graecum* to STZ rats led to a decrease in blood glucose levels by 14.4 and 46.6% on the 15th and 30th day of the experiment, respectively. Renal glycogen content increased by over 10-fold, whereas hepatic and skeletal muscle glycogen content decreased by 75 and 68%, respectively, in diabetic control rats versus normal control rats. Acombination dose deof vanadate (sodium orthovanadate, a common drug prescribed for treating diabetes) at 0.2 mg/ml and *T. foenumgraecum* seed powder at 5% w/w to alloxan-diabetic rats reduced blood glucose levels to that of control non-diabetic rats (Mohamed *et al.,* 2004). The potential of natural plant product synthetic drug combination.


Figure 2.1: ***Trigonella foenum-graecum*** **(Mathi).**

2.1.1.2 ***Eugenia jambolana Lam. syn. Syzygium cumini*** **L. Skeets.**

Taxonomic position of the *Syzygium cumini* L. Skeets

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Family : Myrtaceae

Order : Myrtales

Genus : *Syzygium* L.

Species : S. *cumini*

Eugenia jambolana, called "jamun", black plum or Indian black berry, has been more extensively researched for its hypoglycemic and antihyperglycemic properties (Grover *et al.,* 2002; Ravi *et al.,* 2004) evaluated the hypoglycemic activity of the whole seed, kernel, and seed coat of *E. jambolana* seeds on STZ-induced diabetic rats. The ethanol extract of seed kernel alone at a concentration of 100 mg/kg body weight significantly decreased the levels of blood glucose, blood urea, cholesterol, the activities of glutamate oxaloacetate transaminase and glutamate pyruvate transaminase,

and increased glucose tolerance and levels of total proteins and liver glycogen in experimental diabetic rats. The hypoglycemic efficacy of seed kernels was similar to that of glibenclamide, a standard hypoglycemic drug. In a study reported by (Pepato *et al.,* 2005), continuous administration of *E. jambolana* lyophilized fruit-pulp to STZ-diabetic rats for 40 days did not show any differences in glycaemia, urinary urea and glucose body weight, food or water intake, urine volume, and hepatic glycogen of diabetic rats receiving 50 mg/day compared with the control diabetic. (Sharma *et al.,* 2003) reported that ethanol extract administered at 100 mg/kg body weight to sub-diabetic rabbits for 1 day, moderately diabetic rabbits for 7 days, and severely diabetic rabbits for 15 days resulted a significant reduction in fasting blood glucose levels 90 min after dosing. The reduction in fasting blood glucose was 12, 18.9, and 29% in sub-diabetic, moderately diabetic, and severely diabetic rabbits, respectively. Similarly, the reduction in peak blood glucose was 16.9% in sub-diabetic and 21.0% in moderately diabetic rabbits during glucose tolerance tests. The fasting blood glucose levels were reduced by 41.3% in moderately diabetic and by 31.6% in severely diabetic rabbits after 15 days of treatment. The serum insulin level was significantly increased by 32.8% in moderately diabetic and 26.9% in severely diabetic rabbits. In this study, three plant species with known antidiabetic properties were compared for their relative effectiveness. *Eugenia jambolana* had a greater effect than *Tinospora cordifolia*, but was lower than that of *Momordica charantia*. *Eugenia jambolana* seed is reported to contain several active constituents such as flavonoids, gallic acid, ellagic acid, and tannins (Bhatia and Bhajaj, 1975).


Figure 2.2: *Syzygium cumini*.

2.1.1.3 *Momordica charantia* (Family: Cucurbitaceae)

Taxonomic position of the *Momordica charantia,*

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Family : *Cucurbitaceae*

Order : Cucurbitales

Genus : *Momordica* L.

Species : *M. charantia*

Momardica charantia has a long list of common names and is well known as bitter gourd, balsam pear, or fug kwa. It is a cucurbit vine native to Asia. In Asian and Latin American countries, bitter melon is frequently used as an antidiabetic and antihyperglycemic agent (Ahmed *et al.,* 2001; Miura, *et al.,* 2001). It is probably the most extensively researched species among plant species known for their antidiabetic properties. The fruit has been also shown the ability to enhance the cell's uptake of

glucose, to promote insulin release, and potentiate the effect of insulin. (*Grover et al.,* 2002) provide an extensive review of research on bitter melon's effects on diabetes (Virdi *et al.,* 2003) reported that aqueous extract powder of fresh, unripe whole fruits of *M. charantia* administered to alloxan diabetic rats at 20 mg/kg twice daily for a 4-week period reduced blood glucose levels by 48% and reversed hyperglycaemia to levels obtained with that by the synthetic drug glibenclamide. The study also showed that *M. charantia* did not have nephrotoxicity or hepatotoxicity. In both STZ-induced Type 1 diabetic rats (Ahmed *et al.,* 2001) and KK-Ay Type 2 diabetic mice (Miura *et al.,* 2004), M. *charantia* fruit extract-supplemented diets reduced blood serum glucose levels significantly compared with that of control non-diabetic rats. In other studies, bitter melon fruit juice also exhibited an inhibitory effect on membrane nonesterified cholesterol under *in vitro* conditions. Administration of 50 g of charantin reduced blood glucose levels by 42% in 4 h with a mean reduction of 28% during the 5-h-test reported by (Lolitkar and Rao, 1966). In a study reported by (McWhorter, 2001), the hypoglycemic activity was attributed to vicine, a pyrmadine nucleoside, polypeptide-p, and charantin containing mixed sterols that influence glucose uptake, glycogen synthesis in muscle and liver, and suppress glucose synthesis.

Figure 2.3: *Momordica charantia*.

2.1.1.4 *Ficus benghalensis* (Moraceae, Mulberry family)

Taxonomic position of the *Ficus benghalensis*

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Family : *Moraceae*

Order : Rosales

Genus : *Ficus* L.

Species : *F. benghalensis*

Ficus benghalensis (Moraceae) is commonly known as Banyan tree or Vata or Vada treein Ayurveda. There are more than 800 species and 2000 varieties of species, most of which are native to the old world tropics. *Ficus benghalensis* a remarkable tree of India sends down its branches and great number of shoots, which take root and become new trunk. This tree is considered to be sacred in many places in India. Earlier glucoside, 20-tetratriaconthene-2-one, 6 heptatriacontene-10-one, pentatriacontan-5-one, beta sitostirol-alpha-D-glucose and meso-inositol have been isolated from the bark of Ficus benghalensis (Subramanian and Misra, 1978; CSIR, 1952). Leaves contain crude protein 9.63%, crude fibres-26.84, CaO-2.53 and Phosphorus-0.4%. It yields latex containing Caoytchoue (2.4%), Resin, Albumin, Cerin, Sugar and Malic acid. It is used in Ayurveda for the treatment of Diarrhea, Dysentery and piles, (Mukherjee *et al.,* 1998; Husain *et al.,* 1992) teeth disorders, (Aiyer, 1960) Rheumatism, skin disorders like sores, (Warrier *et al.,* 1996) to boost immune system, (Gabhe *et al.,* 2006) as a hypoglycemic (Shrotri and Aiman, 1960; Deshmukh *et al.,* 1960; Augusti, 1975; Augusti *et al.,* 1994). The extracts of *Ficus benghalensis* were also reported to

inhibit insulinase activity from liver and kidney (Achrekar *et al.,* 1991). Fruit extracts exhibited antitumor activity in the potato disc bioassay (Mousa *et al.,* 1994). Two flavonoid compounds, viz. 5, 7-dimethyl ether of leucopelargonidin 3-0-alpha-L rhamnoside and 5, 3,-dimethyl ether of leucocyanidin 3-0-alpha-D galactosyl cellobioside were obtained from the bark of *F. benghalensis* evaluated for antioxidant activity in hyperlipidemic rats (Daniel *et al.,* 1998). It was also found to inhibit the lipid peroxidation (Shukla *et al.,* 2004). Various extracts of *Ficus benghalensis* was screened for its anti-allergic and anti-stress potential in asthma by milk induced leucocytosis and milk induced eosinophilia (Taur *et al.,* 2007). Other species of Ficus viz. *Ficus inspida* (Amorin *et al.,* 1999) and *Ficus carica*, (Iqbal *et al.,* 2001).

Figure 2.4 : *Ficus benghalensis*.

2.1.1.5 *Azadirachta indica*

Taxonomic position of the *Azadirachta indica*

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Family : Meliaceae

Order : Sapindales

Genus : *Azadirachta* L.

Species : *A. indica*.

Diabetes mellitus is a metabolic syndrome characterized by an increase in the blood glucose level. Treatment of diabetes is complicated due to multifactorial nature of the disease. *Azadirachta indica* Adr. Juss and Bougainvillea spectabilis are reported to have medicinal values including antidiabetic properties. In the present study using in vivo diabetic murine model, *A. indica* and *B. spectabilis* chloroform, methanolic and aqueous extracts were investigated for the biochemical parameters important for controlling diabetes. It was found that *A. indica* chloroform extract and *B. spectabilis* aqueous, methanolic extracts showed a good oral glucose tolerance and significantly reduced the intestinal glucosidase activity. Interestingly, *A. indica* chloroform and *B. spectabilis* aqueous extracts showed significant increase in glucose-6-phosphate dehydrogenase activity and hepatic, skeletal muscle glycogen content after 21 days of treatment. In immunohistochemical analysis, we observed a regeneration of insulin-producing cells and corresponding increase in the plasma insulin and c-peptide levels with the treatment of *A. indica* chloroform and *B. spectabilis* aqueous, methanolic extracts. Analyzing the results, it is clear that *A. indica* chloroform and *B.*

spectabilis aqueous extracts are good candidates for developing new neutraceuticals treatment for diabetes (Menakshi Bha *et al.,* 2011).

Figure 2.5: ***Azadirachta indica*.**

2.1.1.6 *Cinnamomum tamala* (nees.)

Taxonomic position of the *Cinnamomum tamala*

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Family : *Lauraceae*

Order : Magnoliales

Genus : *Cinnamomum* N.

Species : *C. tamala*

The aqueous extracts of *Cinnamomum tamala* (CTLEt) leaves on blood glucose of albino rats. CTLEt was administered at doses of 125 and 250 mg/kg body weight

respectively on streptozotocin induced diabetic rats for 3 weeks. Diabetic rats had much reduced body weight than normal rats. Administration of the extracts at the dose of 250 mg/kg body wt. day resulted in a marked decrease in the levels of fasting blood glucose and urine sugar, with a concomitant increase in body weight. The extract also produced a significant decrease in peroxidation products, *viz*., thiobarbituric acid reactive substances. Reduced glutathione and glycogen content, which had shown significant decrease following induction of diabetes, were found to be increased in the hepatic tissue of STZ-diabetic rats treated with CTLEt. STZ-diabetic rats treated with CTLEt (250mg/kg) significantly reversed all these changes to near normal. Quantification of antioxidants of the leaves-phenols, ascorbate and carotenoids revealed that *C. tamala* leaves had high antioxidants. These results suggest that CTLEt induce antihyperglycemic as well as antioxidant activities in STZ-diabetic rats (Usha Chakraborty and Hariswami Das, 2010).

Figure 2.6: *Cinnamomum tamala*.

3. METHODOLOGY

An interventional follow up study was conducted to find out the role of Ayurvedic medicine in the treatment of Diabetes mellitus and socio-demographic characteristics of the respondents and attributes associated with the role of Ayurvedic medicine in the treatment of Diabetes mellitus. The study was carried out at the privet chamber, Mirpur, Dhaka. This study was conducted as per following methodology:

3.1 TYPE OF STUDY

Interventional follow up Study.

3.2 PLACE OF STUDY

Privet chamber, Mirpur, Dhaka.

3.3 STUDY POPULATION

All patients were enrolled after considering all selection criteria. This chamber based interventional study was conducted from July 2006 to June 2007.

3.4 DEMOGRAPHIC VARIABLE

i) Age of patient

ii) Sex

3.5 CLINICAL VARIABLES

i) Diabetes

3.6 INVESTIGATION VARIABLE

i) RBS

ii) Urine for R/E

iii) Urine C/S

iv) Stool RME

3.7 SAMPLING TECHNIQUE

Purposive Sampling 450

To perform the experiment, 450 male subjects within 40 to 65 years aged were randomly divided into 9 equal groups. Moreover, 450 female subjects within 40 to 65 years aged were also randomly divided into 9 equal groups. one group was kept as normal control group (A) and another 1 (one) group was kept as diabetic control group (B) and in other 6 (six) groups – group (C), group (D), group (E), group (F), group (G), group (H), were treated with single Ayurvedic drugs and group (I) was treated with synthetic drugs. After one month among them normal control group (A) and diabetic control group (B) were kept without giving any other treatment and remaining six groups- group (C), group (D), group (E), group (F), group (G), group (H), were treated with single Ayurvedic drugs and group (I) was treated with synthetic drugs correspondingly. Then blood glucose and other complications of all groups were measured (measured by Accu check advantage blood glucose system and verbal history of subjects). After three (3) months, same activity or course of action has been done chronologically.

To perform the experiment, 100 male subjects within 40 to 65 years aged were randomly divided into 4(Four) equal Groups. One Group was kept as normal control

group (A) and another 1 (one) group was kept as diabetic control group (B) and in other 2 (two) groups – group (C) was treated with combine Ayurvedic drugs and group (D) was treated with synthetic drugs. after one month among them normal control group (A) and diabetic control group (B) were kept without giving any other treatment the remaining 2(two) groups- group (C) were treated with combined Ayurvedic drugs and group (D) were treated with synthetic drugs correspondingly. 100 female subjects within 40 to 60 years aged were randomly divided into same 4 (four) equal groups.

3.8 SELECTION CRITERIA

In this study, fresh and newly diagnosed patients are of type 2 diabetes mellitus were selected.

They were selected with the following criteria:

- Polyuria
- Polydipsia
- Polyphagia
- Nocturia
- Tiredness
- Fasting Blood Sugar > 126mg/dl
- Postprandial Blood sugar > 200mg/dl (2 hours after taking 75 gm glucose dissolved in 300 ml of water)

To perform the experiment, 450 male and 450 female subjects within 40 to 65 years aged were randomly divided into 9 equal groups. One Group was kept as normal control Group (A) and another 1 (One) group was kept as Diabetic control group (B).

In other 6 (Six) groups - *Trigonella foenum-graecum* (Mathi) group (C), *Syzygium cumini* (Jam beez) group (D), *Momordica charantia* (Korolla) group (E), *Ficus benghalensis* (Bot) group (F), *Azadirachta indica* (Neem) group (G), *Cinnamomum tamala* (Tejpata) group (H), was treated with Single Ayurvedic drugs and group (I) was treated with synthetic drugs. Finally 100 male and 100 female subjects within 40 to 65 years aged were randomly divided into 4 (Four) equal groups. One group was kept as normal control group (A) and another 1 (One) group was kept as diabetic control group (B) and in other 2 (Two) groups – group (C) was treated with combined Ayurvedic drugs and group (D) was treated with synthetic drugs.

3.9 INCLUSION CRITERIA

Patient having diabetes to participate

3.10 EXCLUSION CRITERIA

The exclusion criteria included

- History of ischemic heart disease;
- Pregnant and lactating women;
- Patients receiving corticosteroid (Dexamethason) treatment;
- Patients with history of gastritis, peptic ulcer, bleeding ulcers; HIV, HBV;
- Known allergic reaction to systemic/topical study drugs;
- Unwilling to participate

3.11 SAMPLING TECHNIQUE

Privet chamber, Mirpur, Dhaka. was selected purposively for the convenience of the study. Purposive sampling technique was adopted. During the data collection period those fulfilled the study selection criteria were included in the study.

3.12 DATA COLLECTION INSTRUMENT

A semi-structured questionnaire was developed using the selected variables according to the objectives. The questionnaire contained questions related to: 1) socio-demographic characteristics, 2) Diabetes characteristics and other relevant information. Prior to original data collection, a pre-test session was conducted among 10 cases. Necessary modification was done before finalized the questionnaire.

3.13 DATA COLLECTION TECHNIQUE

The researcher collected data through interview. The interview was conducted anonymously as far as possible .Before preceding the data collection, the detail of the study was explicitly explained to each eligible respondent and verbal consents from the respondents were obtained. Diabetes was diagnosed by clinical examination. Documents of the respondents were reviewed for physical and psychological illness.

3.14 STATISTICAL ANALYSIS OF DATA

Statistical analysis of the result was obtained and the result was presented in tables, figures and diagrams. The 95% confidence intervals (CI) were calculated for these values.

3.15 SELECTED PLANTS

The experiment was conducted to investigate combined the following herbs:

1. *Trigonella foenum-graecum* (Mathi)
2. *Azadirachta indica* (Neem)
3. *Syzygium cumini* (Jam beez)
4. *Cinnamomum tamala* (Tejpata)
5. *Ficus benghalensis* (Bot)
6. *Momordica charantia* (Korolla)

In diabetic patients attempts were also to study the comparative efficacy of this combined preparation and synthetic drugs (like glibenclamide, metformin) on blood glucose level and some of these had proved remarkable to cure diabetes and its complications.

3.16 COMBINED AYURVEDIC DRUG

In this study, a compound formulation of drugs was being selected for the treatment of diabetes mellitus and contains six ingredients –

a. *Trigonella foenum-graecum* (Mathi)
b. *Azadirachta indica* (Neem)
c. *Syzygium cumini* (Jam beez)
d. *Cinnamomum tamala* (Tejpata)
e. *Ficus benghalensis* (Bot)
f. *Momordica charantia* (Korolla)

Every of the drugs are mention in the Ayurvedic literature, which is shown by the recent pharmacological studies.

3.17 METHOD OF PREPARATIONS OF TEST DRUG

Each 5 gm Contained

1. *Trigonella foenum-graecum* (Mathi) :1.70gm
2. *Azadirachta indica* (Neem) : 0.26gm
3. *Syzygium cumini* (Jam beez) : 1.48gm
4. *Cinnamomum tamala* (Tejpata) : 0.58gm
5. *Ficus benghalensis* (Bot) : 0.72gm
6. *Momordica charantia* (Korolla) : 0.26gm

3.18 DOSAGE OF THE TEST DRUG

Dose of combined Ayurvedic preparation is 100mg/kg body weight.

3.19 CONTROL DRUG

Standard anti-diabetic drug i.e. Metfo 500mg (Metformin 500 mg) was given once daily at night after meal to the one group of diabetic patients.

3.20 INVESTIGATION REQUIRED

The following investigations were carried out in each patient of all groups.

3.20.1 Investigations for the Assessment of Efficacy

- Blood sugar Fasting and Postprandial (2 hours after taking 75 gm glucose)
- Urine R/E
- HbA1c (Glycated Hemoglobin)

3.20.2 Investigations for the Assessment of Safety

- CBC and ESR
- Blood Urea
- Serum creatinine.

3.20.3 Further Investigations

- X-ray Chest of P/A view
- E.C.G.
- Lipid Profile

3.21 DURATION OF STUDY

The duration of study was 1 (one) year. 900 patients (male and female) for single drugs and 200 Patients (male and female) for combined Ayurvedic drugs had been selected during the course of this study.

3.22 TEST DRUG PRODUCTION PROCEDURE

3.22.1 Cleaning Herbs

Cleaning herbs is an important step for a good quality herbal product. At first in this process raw herbs (whole herbs or grains) will had to de-dusted at first through a de-duster machine or manually. By this process large particles with the raw herbs were sorted out easily.

3.23.1 Drying

Drying section must take the cleaned raw herbs from the cleaning section. Fluid bed dryer was used to dry the raw herbs and took about 15-20 minutes under 55° to 60° temperature. The moisture range of the dried herbs was 10 – 14%.

3.23.2 Herbs Crushing

Properly dried raw herbs were crushed and pulverized by a pulverize machine and turn into powder.

3.23.3 Herbs Sieving

Herbs powders had been passed through a particular messed net so that the bigger particle of the powder might be separated from the total fine powder.

3.23.4 Mixing

Mixing order of any product is very important procedure. Efficacy of that specific product depends on this procedure. For this purpose, some liquid was added (according to formulation) with the powder for proper granulation. The total time was consumed more than 25 minutes (according to characteristics of the herbs). Then a unique mixture was prepared.

3.23.5 Mixed Powder Drying

When the raw powder for a capsule mixed thoroughly some liquid were used to complete the procedure. As a result, the moisture content raised at high than the normal limit. It was mandatory that the moisture limit of the mixed powder will have to be 3-4%.

4. RESULTS

4.1 INTRODUCTION

The experiment was conducted to investigate the Ayurvedic and allopathic drugs on diabetes and some of these have proved remarkable to control of diabetes mellitus and its complications. To perform the experiment, 450 male subjects within 40 to 65 years aged were randomly divided into 9 equal groups. Moreover, 450 female subjects within 40 to 65 years aged were also randomly divided into 9 equal groups. one group was kept as normal control group (A) and another 1 (one) group was kept as diabetic control group (B) and in other 6 (six) groups – group (C), group (D), group (E), group (F), group (G), group (H), were treated with single Ayurvedic drugs and group (I) was treated with synthetic drugs. After one month among them normal control group (A) and diabetic control group (B) were kept without giving any other treatment and remaining six groups- group (C), group (D), group (E), group (F), group (G), group (H) were treated with single Ayurvedic drugs and group (I) was treated with synthetic drugs correspondingly. Then blood glucose and other complications of all groups were measured (measured by Accu check advantage blood glucose system and verbal history of subjects). After three (3) months, same activity or course of action had been done chronologically.

4.2 FOR MALE

Table 4.2.1: Blood glucose average (mmol/L) * in fasting and random blood sugar test of male diabetic patient n=450.

After three months, the RBS of group-A had 6.39, group-B had 11.32, group-C had 8.88, group-D had 8.93, group-E had 8.96, group-F had 9.19, group-G had 9.23, group-H had 9.40, group-I had 8.75 of m mol/L. The value of glucose level had lower after using all drugs.

Sl. No	Name of the Group	Result (m mol/L)							
		1st Day		After 1 month		After 2 month		After 3 month	
		FBS	RBS	FBS	RBS	FBS	RBS	FBS	RBS
1.	Group (A)	5.45	6.05	5.40	6.31	5.12	6.24	5.23	6.39
2.	Group (B)	10.02	10.67	10.05	11.58	9.76	10.98	9.25	11.32
3.	Group (C)	11.06	11.50	9.87	11.26	8.91	10.75	6.32	8.88
4.	Group (D)	10.98	11.46	10.56	11.29	9.56	10.82	5.65	8.93
5.	Group (E)	11.95	12.05	9.28	11.36	8.66	10.98	5.87	8.96
6.	Group (F)	11.83	12.13	10.43	11.45	8.90	11.04	6.54	9.19
7.	Group (G)	11.01	11.67	9.98	11.32	10.00	10.97	7.21	9.23
8.	Group (H)	11.23	12.01	8.90	11.43	7.99	11.02	5.98	9.40
9.	Group (I)	12.76	13.22	10.21	11.54	8.47	10.76	6.71	8.75

***Standard Blood sugar level:**

Random Blood Sugar (RBS): 7.8m mol/L

Fasting Blood Sugar (FBS): 6.5m mol/L

Ref. Davidson's Principles and Practice of Medicine [20th Edition]

Figure 4.2.1: Blood glucose levels (m mol/L) of male diabetic patient in test of fasting blood sugar n=450.

The figure 4.2.1 shows the effect of the drugs had better efficacy among male.

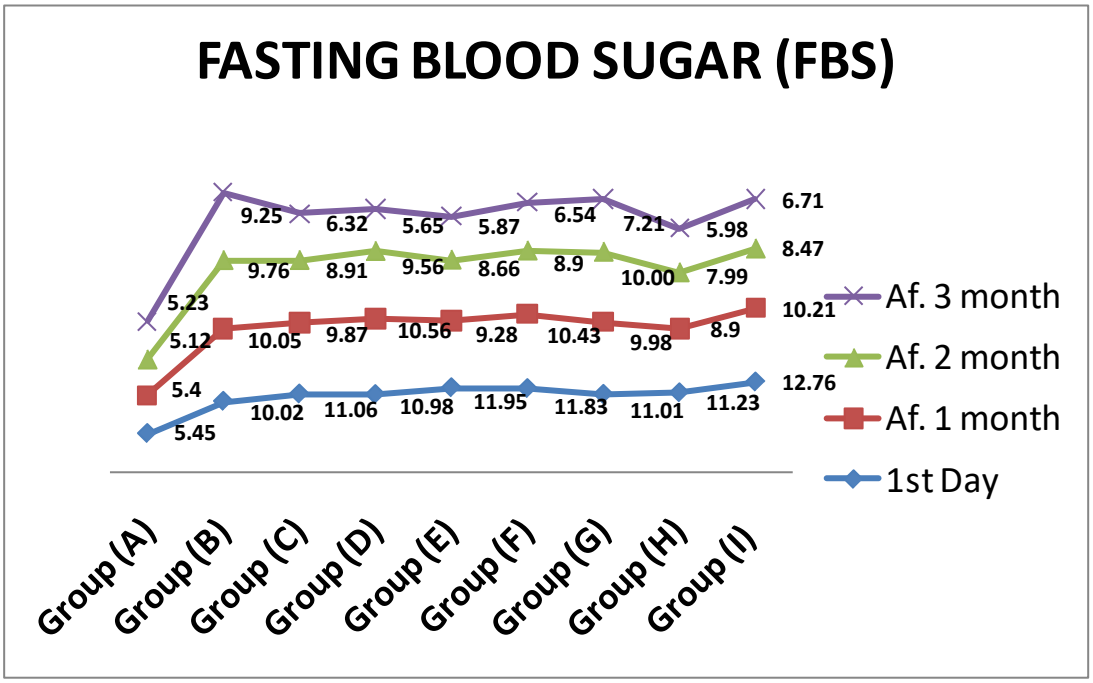


Figure 4.2.2: Blood glucose levels (m mol/L) of male diabetic patient in test of random blood sugar n=450 Table: 1.1 List of anti-diabetic plants of Puducherry.

The figure 4.2.2 shows the effect of the drugs had better efficacy among males.

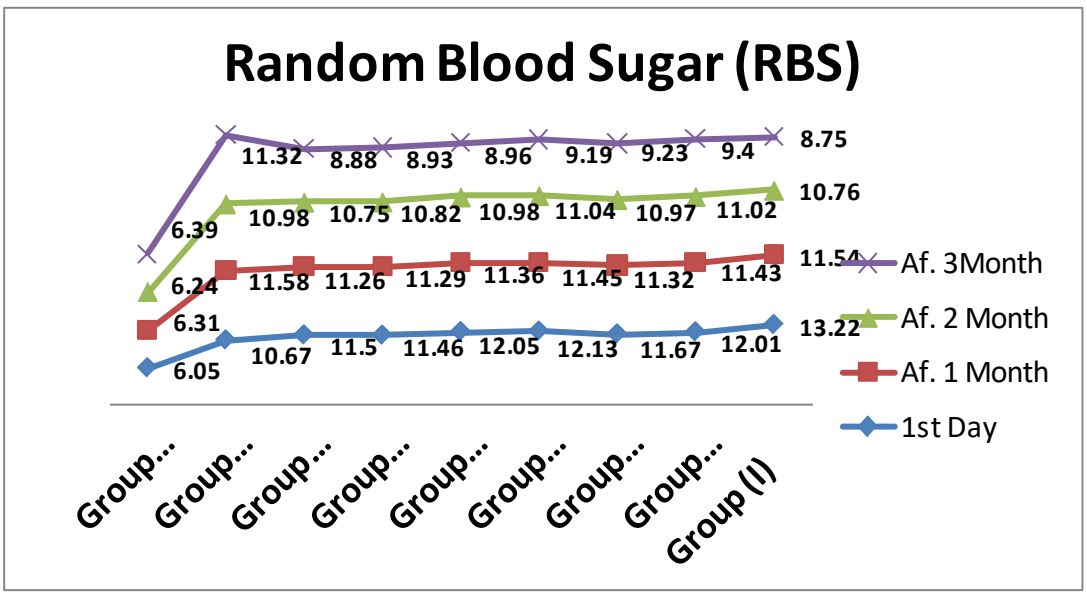


Table 4.2.2: Effect of Single diabetic plants and synthetic drugs in blood glucose (m mol/L) on random blood sugar (RBS) of male diabetic patient n=450.

After three months the result of RBS in control group had 11.32, Mathi group had 8.88, jam beez group had 8.93, corolla group had 8.96, Bot group had 9.19, neem group had 9.23, tejpata group had 9.40, and synthetic group had 8.75 m mol/L. All the drugs had better efficacy.

Sl. No.	Name of the Group	Result / Effectiveness			
		1st Day (m mol/L)	After 1 Month (m mol/L)	After 2 Month (m mol/L)	After 3 Month (m mol/L)
1.	Normal Control Group	6.05	6.31	6.24	6.39
2.	Diabetic Control Group	10.67	11.58	10.98	11.32
3.	*Trigonella foenum-graecum* (Mathi)	11.50	11.26	10.75	8.88
4.	*Syzygium cumini* (Jam beez)	11.46	11.29	10.82	8.93
5.	*Momordica charantia* (Korolla)	12.05	11.36	10.98	8.96
6.	*Ficus benghalensis* (Bot)	12.13	11.45	11.04	9.19
7.	*Azadirachta indica* (Neem)	11.67	11.32	10.97	9.23
8.	*Cinnamomum tamala* (Tejpata)	12.01	11.43	11.02	9.40
9.	Synthetic Drugs Group	13.22	11.54	10.76	8.75

Table 4.2.3: Effect of single Ayurvedic drugs and synthetic drugs in urine for sugar or glucose test of male diabetic patient * n=450.

From Table 4.2.3, it was observed that the normal control group (A) of subjects, clinical record of sugar in urine was (0) and the diabetic control group (B) had clinical record of sugar in urine was (++). There was a significant effect among all the treatments which were applied. After the administration of *Trigonella foenum-graecum (*Mathi) (C), *Syzygium cumini (*Jam beez) (D), *Momordica charantia (*Korolla) (E), *Ficus benghalensis (*Bot) (F), *Azadirachta indica (*Neem) (G), *Cinnamomum tamala (*Tejpata) (H), the level of glucose decreased significantly in urine respectively. On the other hand, the synthetic drug (I) also significantly decreased urine glucose levels.

Sl. No	Name of the Group	Result / Effectiveness							
		1st Day (mmol/L)		After 1 Month (mmol/L)		After 2 Month (mmol/L)		After 3 Month (mmol/L)	
		Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record
1.	Group (A)	Blue	0	Blue	0	Blue	0	Blue	0
2.	Group (B)	Yellow	++	Orange	+++	Yellow	++	Orange	+++
3.	Group (C)	Orange	+++	Orange	+++	Yellow	++	Green	+
4.	Group (D)	Orange	+++	Orange	+++	Yellow	++	Green	+
5.	Group (E)	Orange	+++	Orange	+++	Yellow	++	Green	+
6.	Group (F)	Orange	+++	Orange	+++	Orange	+++	Yellow	++

Sl. No	Name of the Group	Result / Effectiveness							
		1st Day (mmol/L)		After 1 Month (mmol/L)		After 2 Month (mmol/L)		After 3 Month (mmol/L)	
		Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record
7.	Group (G)	Orange	+++	Orange	+++	Yellow	++	Yellow	++
8.	Group (H)	Orange	+++	Orange	+++	Orange	+++	Yellow	++
9.	Group (I)	Orange	+++	Orange	+++	Yellow	++	Green	+

Note*:

Urine testing for glucose is the most usual procedure for detecting Diabetes. This is not Diagnostic of Diabetes but indicates the need for further investigation.

❖ If no glucose is present, solution will remain Blue.

❖ If glucose is present-

- A Green precipitate indicates <0.5% glucose (+).
- A Yellow precipitate indicates 0.5-1% glucose (++).
- An Orange precipitate indicates 1-2% glucose (+++).
- A Red or Brick red color precipitate indicates >2% glucose (++++).

4.3 FOR FEMALE

To perform the experiment, 450 female subjects within 40 to 65 years aged were randomly divided into 9 equal groups that described earlier.

Table 4.3.1: Blood glucose average (m mol/L) in fasting and random blood sugar test of female diabetic patient n=450.

After three months the RBS of group-A had 6.70, group-B had 11.33, group-C had 8.98, group –D had 9.03, group-E had 9.09, group-F had 9.19, group-G had 9.28, group-H had 9.47, group-I had 8.90 of m mol/L. All groups had lower glucose level.

Sl. No.	Name of the Group	Result (m mol/L)							
		1st Day		After 1 month		After 2 month		After 3 month	
		FBS	RBS	FBS	RBS	FBS	RBS	FBS	RBS
1.	Group (A)	5.22	6.15	5.45	6.43	6.02	6.32	5.98	6.70
2.	Group (B)	6.34	10.98	7.87	11.58	6.79	10.89	7.56	11.33
3.	Group (C)	7.87	11.98	6.98	11.41	7.91	10.91	6.94	8.98
4.	Group (D)	8.10	11.65	8.56	11.31	8.09	10.82	7.11	9.03
5.	Group (E)	7.34	12.11	8.21	11.39	9.11	11.01	8.01	9.09
6.	Group (F)	9.21	12.23	6.79	11.45	6.78	11.04	6.87	9.19
7.	Group (G)	7.98	11.67	9.02	11.19	7.11	11.11	7.23	9.28
8.	Group (H)	6.67	12.21	8.12	11.40	6.17	11.07	8.03	9.47
9.	Group (I)	5.98	13.13	5.98	11.42	6.12	10.71	5.99	8.90

Figure 4.3.1: Blood sugar levels (m mol/L) in test of fasting blood sugar of female diabetic patient n=450.

The figure 4.3.1 reveals that all groups' had better efficacy

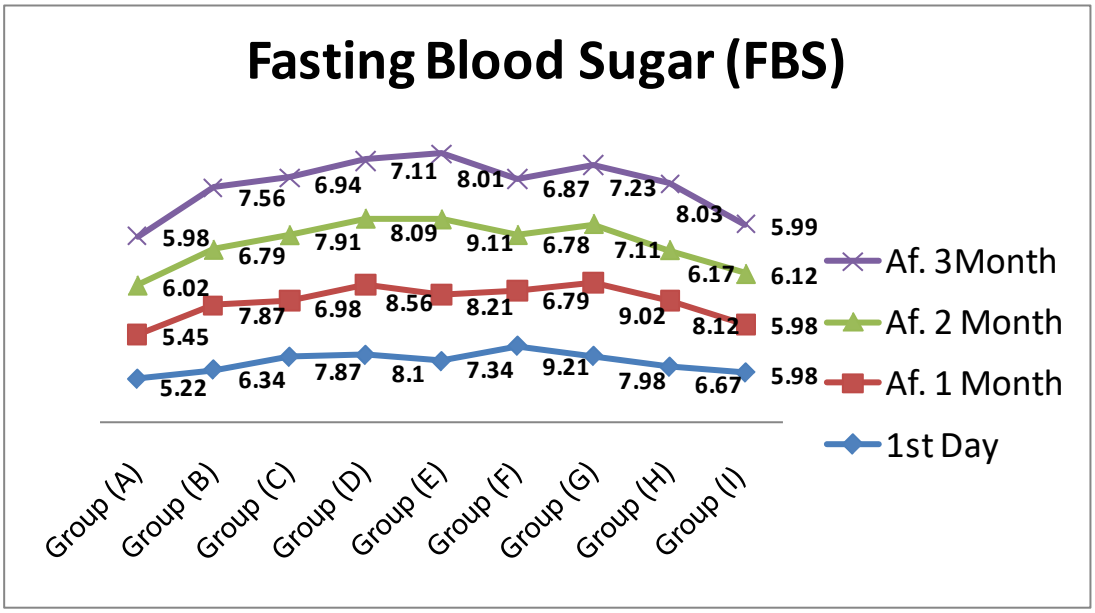


Figure 4.3.2: Blood sugar levels (m mol/L) in test of random blood sugar of female diabetic patient n=450.

The figure 4.3.2 reveals that all groups' had better efficacy

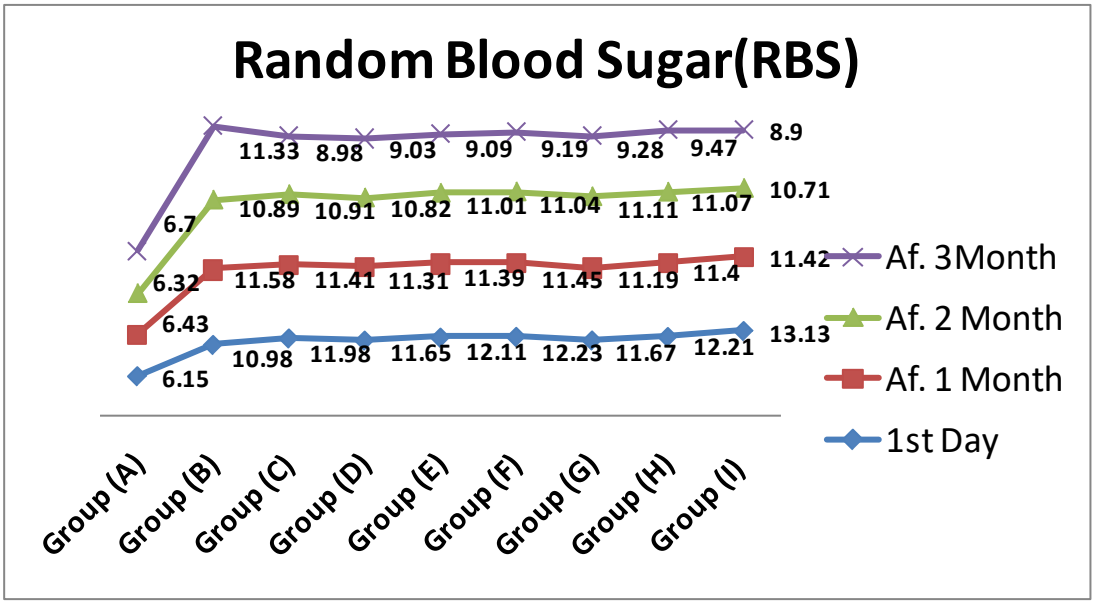


Table 4.3.2: Effect of single Ayurvedic drugs and synthetic drugs to maintaining normal blood glucose (m mol/L) * on random blood sugar test in female diabetic patient.

After three months the result of RBS in control group had 11.33, Mathi group had 8.98, jam beez group had 9.03, corolla group had 9.09, Bot group had 9.19, neem group had 9.28, tejpata group had 9.47, and synthetic group had 8.90 m mol/L. All drugs had better efficacy.

Sl. No:	Name of the Group	Result / Effectiveness			
		1st Day (mmol/L)	After 1 Month (mmol/L)	After 2 Month (mmol/L)	After 3 Month (mmol/L)
1.	Normal Control Group	6.15	6.43	6.32	6.70
2.	Diabetic Control Group	10.98	11.58	10.89	11.33
3.	*Trigonella foenum-graecum* (Mathi)	11.98	11.41	10.91	8.98
4.	*Syzygium cumini* (Jam beez)	11.65	11.31	10.82	9.03
5.	*Momordica charantia* (Korolla)	12.11	11.39	11.01	9.09
6.	*Ficus benghalensis* (Bot)	12.23	11.45	11.04	9.19
7.	*Azadirachta indica* (Neem)	11.67	11.19	11.11	9.28
8.	*Cinnamomum tamala* (Tejpata)	12.21	11.40	11.07	9.47
9.	Synthetic Drugs Group	13.13	11.42	10.71	8.90

*Dose of any single diabetic plants (test drug) is 50mg/kg body weight and synthetic drugs according to preparation.

Table 4.3.3: Effect of single Ayurvedic drugs and synthetic drugs in urine for sugar or glucose test of female diabetic patient.

From Table 4.3.3, it was observed that the control group of subjects, clinical record of sugar in urine was (0) and the diabetic control group had clinical record of sugar in urine was (++). There was a significant effect among all the treatments which were applied. After the administration of *Trigonella foenum-graecum* (Mathi) (C), *Syzygium cumini* (Jam beez) (D), *Momordica charantia* (Korolla) (E), *Ficus benghalensis* (Bot) (F), *Azadirachta indica* (Neem) (G), *Cinnamomum tamala* (Tejpata) (H), the level of glucose decreased significantly in urine respectively. On the other hand, the synthetic drug (I) also significantly decreased urine glucose levels.

Sl. No.	Name of the Group	Result / Effectiveness							
		1st Day (m mol/L)		After 1 Month (m mol/L)		After 2 Month (m mol/L)		After 3 Month (m mol/L)	
		Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record
1.	Group (A)	Blue	0	Blue	0	Blue	0	Blue	0
2.	Group (B)	Yellow	++	Orange	+++	Yellow	++	Orange	+++
3.	Group (C)	Orange	+++	Orange	+++	Yellow	++	Green	+
4.	Group (D)	Orange	+++	Orange	+++	Yellow	++	Green	+
5.	Group (E)	Orange	+++	Orange	+++	Orange	+++	Yellow	++
6.	Group (F)	Orange	+++	Orange	+++	Orange	+++	Yellow	++
7.	Group (G)	Orange	+++	Orange	+++	Orange	+++	Yellow	++
8.	Group (H)	Orange	+++	Orange	+++	Orange	+++	Yellow	++
9.	Group (I)	Orange	+++	Orange	+++	Yellow	++	Green	+

4.4 RESULTS OF COMBINED AYURVEDIC DRUG

FOR MALE

To perform the experiment, 100 male subjects within 40 to 65 years aged were randomly divided into 4(Four) equal Groups. One Group was kept as normal control group (A) and another 1 (one) group was kept as diabetic control group (B) and in other 2 (two) groups - group(C) was treated with combine Ayurvedic drugs and group (D) was treated with synthetic drugs. after one month among them normal control group (A) and diabetic control group (B) were kept without giving any other treatment the remaining 2(two) groups- group (C) were treated with combined Ayurvedic drugs and group (D) were treated with synthetic drugs correspondingly.

Table 4.4.1: Blood glucose average (m mol/L) in fasting and random blood sugar test of male diabetic patient.

From the table 4.4.1 show, all the drugs had better efficacy.

Sl. No	Name of the Group	Result (m mol/L)							
		1st Day		After 1 months		After 2 months		After 3 months	
		FBS	RBS	FBS	RBS	FBS	RBS	FBS	RBS
1.	Group (A)	5.35	5.55	5.48	5.69	5.23	5.45	5.49	5.58
2.	Group (B)	9.43	9.59	9.55	9.68	9.96	10.25	9.13	9.23
3.	Group (C)	10.86	11.25	10.63	10.85	9.12	9.25	8.32	8.73
4.	Group (D)	10.88	10.95	9.56	9.90	8.47	8.84	8.09	8.23

Figure 4.4.1: Blood glucose level (m mol/L) of male diabetic patient in test of fasting blood sugar (FBS).

In figure 4.4.1 shows that both combine Ayurvedic and synthetic drug had better efficacy.

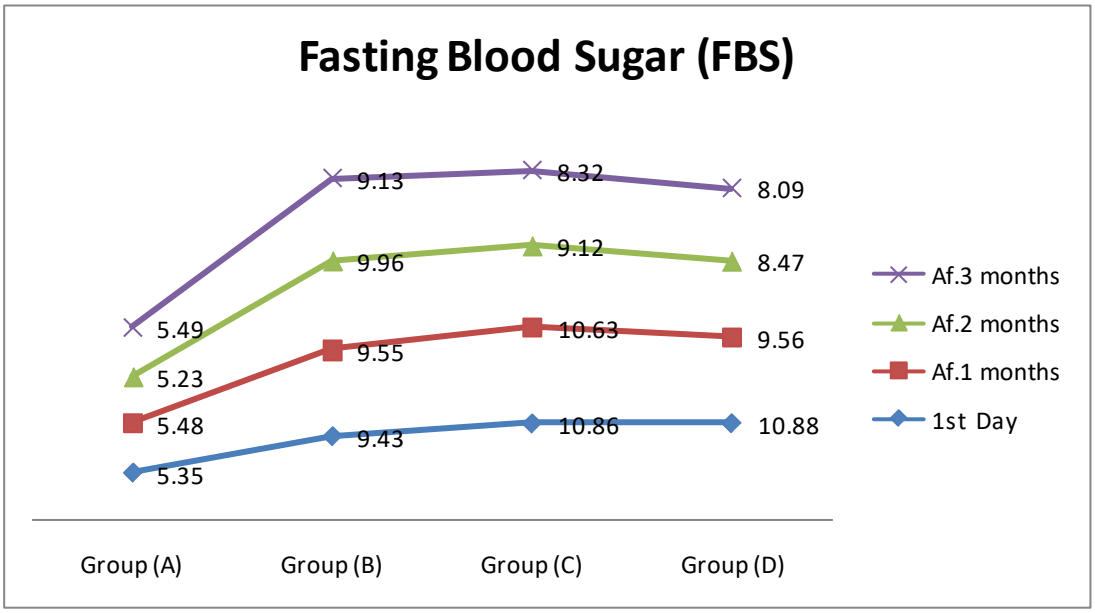


Figure 4.4.2: Blood glucose level (m mol/L) of male diabetic patient in test of random blood sugar (RBS).

In figure 4.4.2 shows that both combine Ayurvedic and synthetic drug had better efficacy.

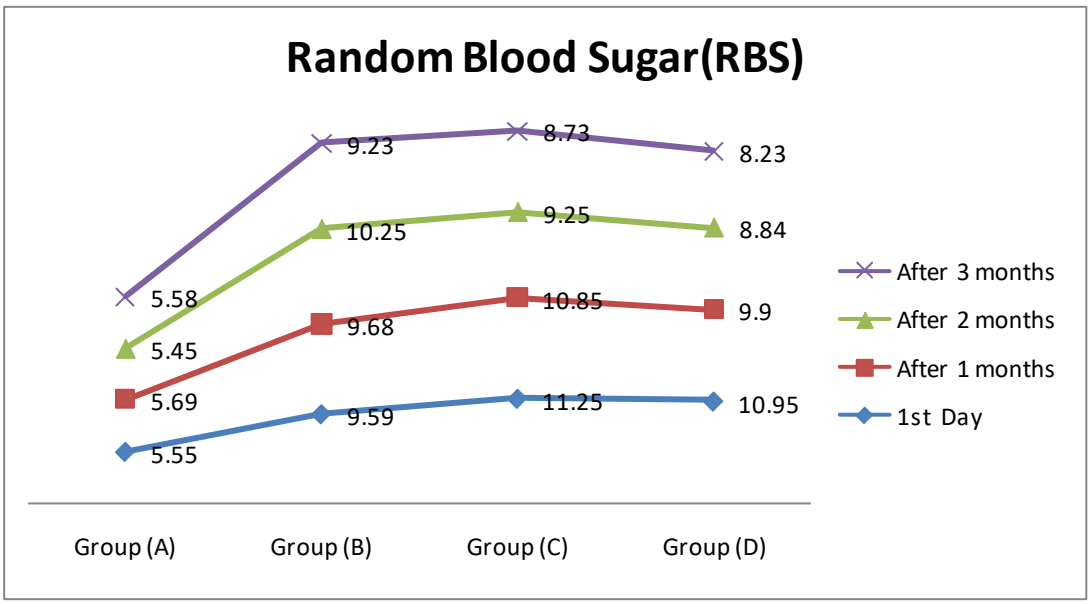


Table 4.4.2: Effect of combine Ayurvedic drugs and synthetic drugs to maintaining normal blood glucose (m mol/L)* on random blood sugar test in male diabetic patient.

After three months the RBS of group-A had 5.58, group-B had 9.23, group-C had 8.73 and group –D had 8.23 of m mol/L. Combine Ayurvedic drug and synthetic drug had better efficacy.

Sl. No	Name of the Group	Result / Effectiveness			
		1st Day	After 1 Month (m mol/L)	After 2 Month (m mol/L)	After 3 Month (m mol/L)
1.	Normal Control Group (A)	5.55	5.69	5.45	5.58
2.	Diabetic Control Group (B)	9.59	9.68	10.25	9.23
3.	Combine Ayurvedic Drugs Group (C)	11.25	10.85	9.25	8.73
4.	Synthetic drugs Group (D)	10.95	9.90	8.84	8.23

*Dose of combined herbal preparation is 100mg/kg body weight and synthetic drugs according to preparation.

Figure 4.4.3: Effect of combine Ayurvedic drugs and synthetic drugs to maintaining normal blood glucose (m mol/L) on random blood sugar test in male diabetic patient.

In figure 4.4.3 shows that combine Ayurvedic drug and synthetic drug had better efficacy

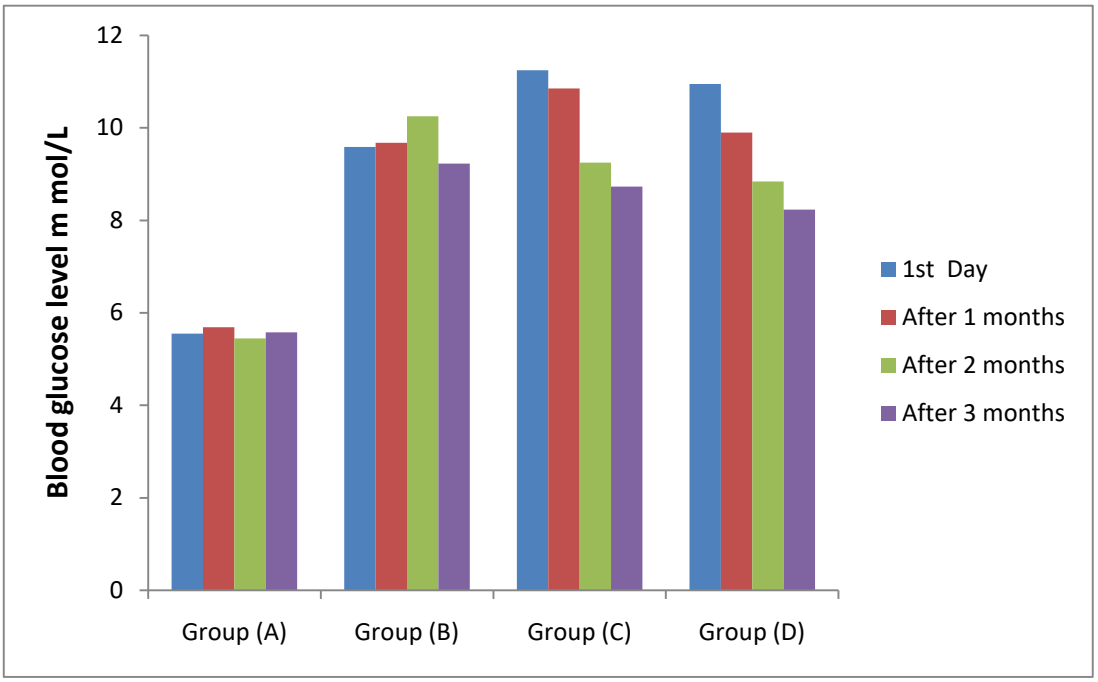


Table 4.4.3: Effect of combine Ayurvedic drugs and synthetic drugs in urine for sugar or glucose test of male diabetic patient.

From Table 4.4.3, it was observed that the Normal control group (A) of the subjects, clinical record of sugar in urine was (0) and the diabetic control group (B) had clinical record of sugar in urine was (++). There was a significant effect among all the treatments which were applied. After the administration of combine Ayurvedic drugs the level of glucose decreased significantly in urine respectively. On the other hand, the synthetic drug also significantly decreased urine glucose levels.

Sl. No	Name of the Group	Result / Effectiveness							
		1st Days		After 1 Months		After 2 Months		After 3 Months	
		Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record
1.	Group (A)	Blue	0	Blue	0	Blue	0	Blue	0
2.	Group (B)	Yellow	++	Yellow	++	Yellow	++	Yellow	++
3.	Group (C)	Orange	+++	Yellow	++	Yellow	++	Green	+
4.	Group (D)	Yellow	++	Yellow	++	Green	+	Green	+

4.5 FOR FEMALE

To perform the experiment, 100 female subjects within 40 to 65 years aged were randomly divided into 4(Four) equal Groups. One Group was kept as normal control

group (A) and another 1 (one) group was kept as diabetic control group (B) and in other 2 (two) groups - group(C) was treated with combine Ayurvedic drugs and group (D) was treated with synthetic drugs. after one month among them normal control group (A) and diabetic control group (B) were kept without giving any other treatment the remaining 2(two) groups- group(C) were treated with combined Ayurvedic drugs and group (D) were treated with synthetic drugs correspondingly.

Table 4.5.1: Blood glucose average (m mol/L) in fasting and random blood sugar test of female diabetic patient.

From the table 4.5.1 show, all the drugs had better efficacy.

Sl. No	Name of the Group	Result (m mol/L)							
		1st Day		After 1 month		After 2 month		After 3 month	
		FBS	RBS	FBS	RBS	FBS	RBS	FBS	RBS
1.	Group (A)	5.65	5.85	5.48	5.79	5.63	5.80	5.39	5.58
2.	Group (B)	9.43	9.59	9.55	9.68	9.96	10.25	9.13	9.23
3.	Group (C)	10.96	11.25	10.63	10.85	9.12	9.30	8.32	8.69
4.	Group (D)	10.88	10.95	9.56	9.90	8.47	8.92	8.09	8.13

Figure 4.5.1: Blood glucose levels (m mol/L) of female diabetic patient in test of fasting blood sugar (FBS).

In figure 4.5.1 shows that both combine Ayurvedic and synthetic drug had better efficacy.

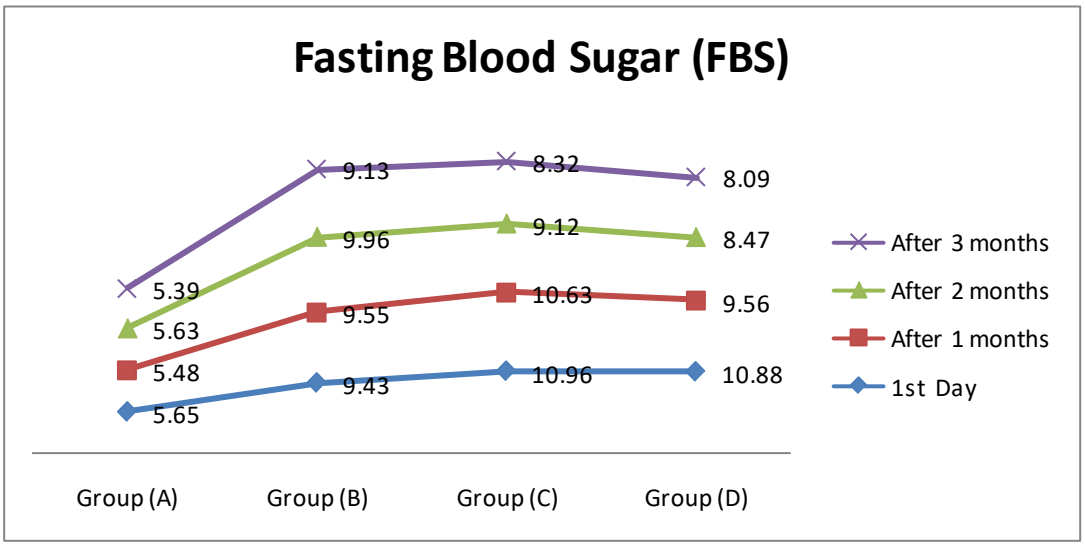
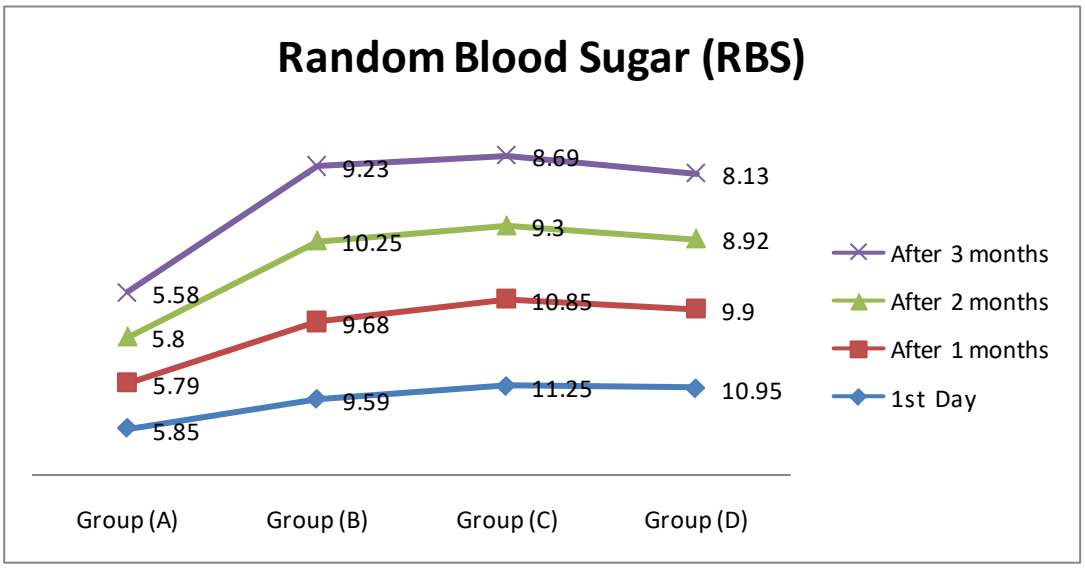


Figure 4.5.2: Blood glucose level (m mol/L) of female diabetic patient in test of random blood sugar (RBS).



In figure 4.5.2 shows that both combine Ayurvedic and synthetic drug had better efficacy.

Table 4.5.2: Effect of combine Ayurvedic drugs and synthetic drugs to maintaining normal blood glucose (m mol/L)* on random blood sugar test in female diabetic patient.

The table shows that after three months the RBS of group-A had 5.58, group-B had 9.23, group-C had 8.69 and group –D had 8.13 of m mol/L. All drugs had better efficacy.

Sl. No	Name of the Group	Result / Effectiveness			
		1st Day	After 1 Months (m mol/L)	After 2 Months (m mol/L)	After 3 Months (m mol/L)
1.	Normal Control Group (A)	5.85	5.79	5.80	5.58
2.	Diabetic Control Group (B)	9.59	9.68	10.25	9.23
3.	Combine Ayyrvedic Drugs Group (C)	11.25	10.85	9.30	8.69
4.	*Synthetic drugs Group* (D)	10.95	9.90	8.92	8.13

*Dose of combined herbal preparation is 100mg/kg body weight and synthetic drugs according to preparation.

Figure 4.5.3: Effect of combine Ayurvedic drugs and synthetic drugs to maintaining normal blood glucose (m mol/L) on random blood sugar (RBS) tests in male diabetic patient.

In figure 4.5.3 shows that combine Ayurvedic drug and synthetic drug had better efficacy

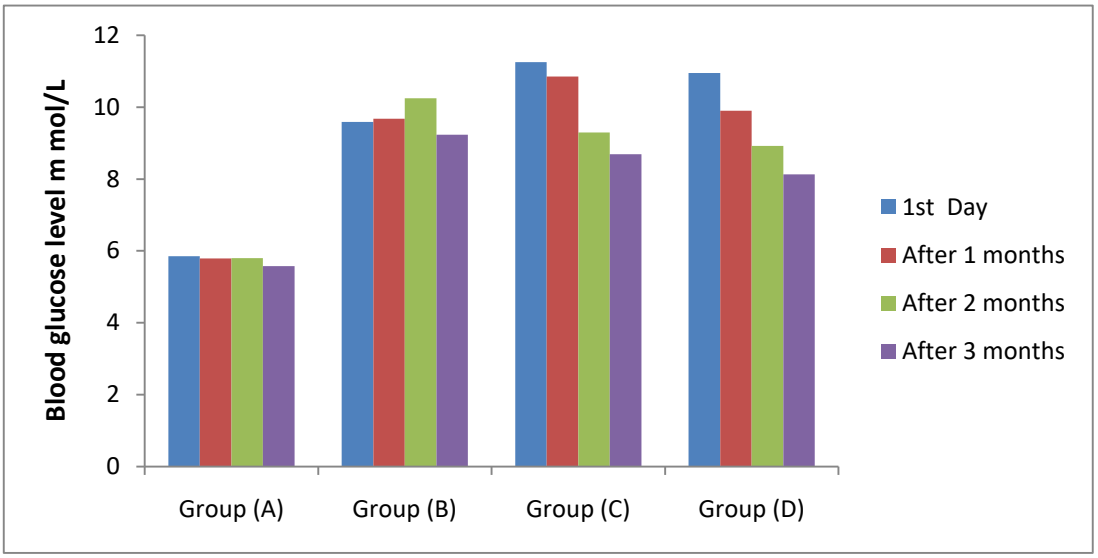


Table 4.5.3: Effect of combine Ayurvedic drugs and synthetic drugs in urine for sugar or glucose test of female diabetic patient.

From Table 4.5.3, it is observed that the Normal control group (A) of subjects, clinical record of sugar in urine was (0) and the diabetic control group (B) had clinical record of sugar in urine is (++). There are significant effects among all the treatments which were applied. After the administration of combined Ayurvedic drugs the level of glucose decreased significantly in urine respectively. On the other hand, the synthetic drug also significantly decreased urine glucose levels.

Sl. No	Name of the Group	Result / Effectiveness							
		1st Days		After 1 Months		After 2 Months		After 3 Months	
		Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record	Obser-vation	Clinical Record
1.	Group (A)	Blue	0	Blue	0	Blue	0	Blue	0
2.	Group (B)	Yellow	++	Yellow	++	Yellow	++	Yellow	++
3.	Group (C)	Orange	+++	Yellow	++	Yellow	++	Green	+
4.	Group (D)	Yellow	++	Yellow	++	Green	+	Green	+

4.6 EFFECTS IN COMPLICATIONS OF DM

4.6.1 For Male

To perform this experiment, At the first day all Groups-normal control group (A), diabetic control group (B), combine*d* Ayurvedic drugs *group* (C), *synthetic drugs group* (D) were measured by Hba1c* (glycated haemoglobin). After one month and after three months same activity or course of action has been done chronologically. At last one thing becomes clear that is reducing complications of diabetes mellitus combined Ayurvedic drugs is significantly more effective than synthetic drugs.

*HbA1c (Glycated Haemoglobin): Glycated Haemoglobin provides an accurate and objective measure of glycemic condition over a period of weeks to months. HbA1c provides an index of risk for developing Diabetic complications. Normal HbA1c Level is <7% and good Glycaemic control: 3.9-6.1 m mol/L

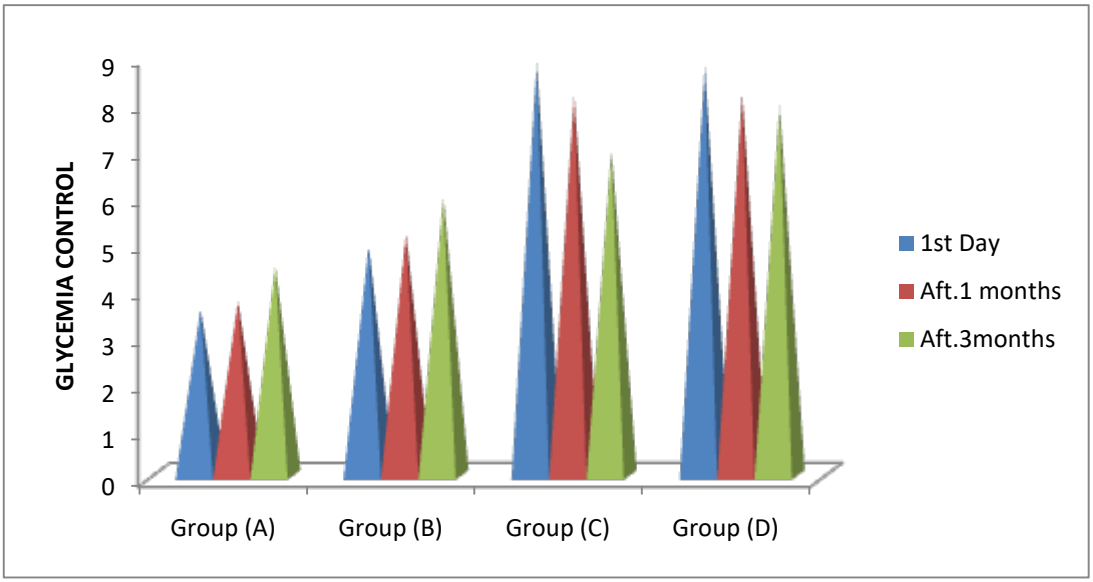
Table 4.6.1.1: Effect of combined Ayurvedic drug and synthetic drugs to reducing complications in male diabetic patient: HbA1c (Glycated Hemoglobin) test.

The table shows that combine Ayurvedic drugs had better efficacy than synthetic drug.

Sl. No:	Name of the Group	Effectiveness		
		1st Day m mol/L	After 1 Months m mol/L	After 3 Months m mol/L
1.	Normal Control Group (A)	3.54	3.72	4.47
2.	Diabetic Control Group (B)	4.90	5.17	5.93
3.	Combine Ayurvedic drugs Group (C)	8.82	8.13	6.94
4.	Synthetic drugs Group (D)	8.74	8.18	7.89

Figure 4.6.1.1: Difference between Effect of combined Ayurvedic drug and synthetic drugs to reducing complications in male diabetic patient: HbA1c (Glycated Hemoglobin) test.

From Figure 4.6.1.1, the result of the effects on controlling glycemia of male diabetic patient following administration of combined Ayurvedic drugs and synthetic drugs. It is observed that combine Ayurvedic drugs is more effective for good glycaemic control. On the other hand, the synthetic drug is less effective for good glycaemic control and good glycaemic control means control of complications of diabetic mellitus.



4.6.2 For Female

To perform this experiment At the first day all Groups-normal control group (A), diabetic control group (B), combine Ayurvedic drugs group (C), synthetic drugs group (D) were measured by hba1c* (glycated hemoglobin) tests. After one month and after three months same activity or course of action has been done chronologically. At last one thing becomes clear that is reducing complications of diabetes mellitus combined Ayurvedic drugs is significantly more effective than synthetic drugs.

*HbA1c (Glycated Haemoglobin): Glycated Haemoglobin provides an accurate and objective measure of glycemic condition over a period of weeks to months. HbA1c provides an index of risk for developing Diabetic complications. Normal HbA1c Level is <7% and Good Glycaemic control: 3.9-6.1 m mol/L

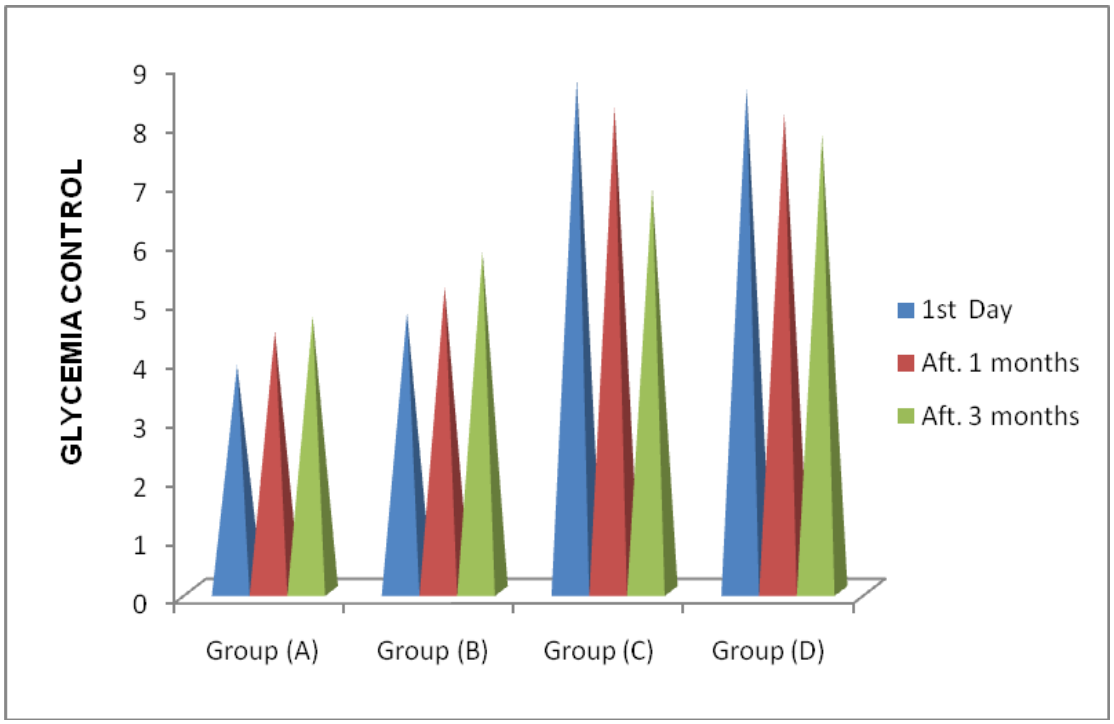
Table 4.6.2.1: Effect of combined Ayurvedic drug and synthetic drugs to reducing complications in female diabetic patient: HbA1c (Glycated Hemoglobin) test.

The table shows that combine Ayurvedic drugs had better efficacy than synthetic drug.

Sl. No.	Name of the Group	Effectiveness		
		1st Day m mol/L	After 1 Months m mol/L	After 3 Months m mol/L
1.	Normal Control Group (A)	3.84	4.42	4.67
2.	Diabetic Control Group (B)	4.73	5.17	5.77
3.	Combine Ayurvedic drugs Group (C)	8.7	8.23	6.85
4.	Synthetic drugs Group (D)	8.55	8.13	7.75

Figure 4.6.2.1: Difference between effect of combined Ayurvedic drug and synthetic drugs to reducing complications in female diabetic patient: HbA1c (Glycated Hemoglobin) test.

Figure 4.6.2.1 shows the result of the effects on controlling glycemia of female diabetic patient following administration of combined Ayurvedic drugs and synthetic drugs. It is observed that combine Ayurvedic drugs is more effective for good glycaemic control. On the other hand, the synthetic drug is less effective for good glycaemic control and good glycaemic control means control of complications of diabetic mellitus.



4.7 FINAL DECISION ABOUT THE COMBINED AYURVEDIC DRUGS

From above all tables and graphs of combined Ayurvedic drugs it was observed that there was a significant effect among all the treatments which were applied. After the administration of combined Ayurvedic drugs, according its dose, through the specific groups there was significantly decreased glucose level as like as the synthetic drug decreased the level of blood glucose. The effectiveness of combined Ayurvedic drugs and synthetic drugs against diabetes mellitus and its complications are given below:

Table 4.7.1: Effect of combined Ayurvedic drug and synthetic drugs to reducing complications in male and female diabetic patients.

The table shows that both combine Ayurvedic drug and synthetic drug had better efficacy.

Sl. No.	Name of the Drugs	Drug Result / Effectiveness							
		Male Diabetic patient (m mol/l)				Female Diabetic patient (m mol/l)			
		1st Days	After 1 Months	After 2 Months	After 3 Months	1st Days	After 1 Months	After 2 Months	After 3 Months
1.	Combine Ayurvedic Drugs	11.25	10.85	9.25	8.73	11.25	10.85	9.30	8.69
2.	Synthetic Drugs	10.95	9.90	8.84	8.23	10.95	9.90	8.92	8.13

Table 4.7.2: Effect of combined Ayurvedic drug and synthetic drugs to reducing complications in male and female diabetic patients: HbA1c (Glycated Hemoglobin) test.

The table shows that combine Ayurvedic drug had better efficacy than synthetic drug. From these results it is observed that After 3 month's administration of combined Ayurvedic drug there was significantly decreased blood glucose level and good glycemic control of diabetic mellitus. On the other hand, the synthetic drug also significantly decreased blood glucose level but less effective in good glycemic control of diabetic mellitus and good glycaemic control means control of complications of diabetic mellitus.

Sl. No.	Name of the Drugs	Glycemic Control Result / Effectiveness					
		Male Diabetic patient (m mol/l)			Female Diabetic patient (m mol/l)		
		1st Days	After 1 Months	After 3 Months	1st Days	After 1 Months	After 3 Months
1.	Combine Ayurvedic Drugs	8.82	8.13	6.94	8.7	8.23	6.85
2.	Synthetic Drugs	8.74	8.18	7.89	8.55	8.13	7.75

5. DISCUSSION

Many useful herbs introduced in pharmacological and clinical trials have confirmed their blood sugar lowering effect, repairing of β-cells of Islets of Langerhans.

To perform the experiment, 450 male subjects within 40 to 65 years aged were randomly divided into 9 equal groups. one group was kept as normal control group (A) and another 1 (one) group was kept as diabetic control group (B) and in other 6 (six) groups - group (C), group (D), group (E), group (F), group (G), group (H) were treated with single Ayurvedic drugs and group (I) was treated with synthetic drugs. After one month among them normal control group (A) and diabetic control group (B) were kept without giving any other treatment and remaining six groups- group (C), group (D), group (E), group (F), group (G), group (H), were treated with single Ayurvedic drugs and group (I) was treated with synthetic drugs correspondingly. Then blood glucose and other complications of all groups were measured (measured by Accu check advantage blood glucose system and verbal history of subjects). After three (3) months, same activity or course of action had been done chronologically. The same activity had been used to 450 female subjects.

Moreover, 100 male subjects within 40 to 65 years aged were randomly divided into 4(Four) equal Groups. One Group was kept as normal control group (A) and another 1 (one) group was kept as diabetic control group (B) and in other 2 (two) groups - group(C) was treated with combine Ayurvedic drugs and group (D) was treated with synthetic drugs. after one month among them normal control group (A) and diabetic control group (B) were kept without giving any other treatment the remaining 2(two)

groups- group (C) were treated with combined Ayurvedic drugs and group (D) were treated with synthetic drugs correspondingly. The same activity had used to 100 female subjects as well.

According to the study of Chakraborty and Das, (2010) by using *Cinnamomum tamala*, there was a significant decrease ($p < 0.01$) in the body weight of the diabetic controls compared with the normal controls.

The experiment was conducted to investigate the herbs *Trigonella foenum-graecum* in diabetic patients. Attempts were also need to study the comparative efficacy of this *Trigonella foenum-graecum* and allopathic drugs on diabetes and some of these proved effect to control of diabetes mellitus and its complications.

Several human intervention trials and animal experiments demonstrated that the anti-diabetic effect of *Trigonella foenum-graecum* seeds ameliorate most metabolic symptoms associated with type I and type II diabetes. The daily use of this may improve the digestibility of eaten food, which may further promote good absorbing capacity of food constituents in blood for best metabolic use in the body cells (Doshi, 2012).

A low (0.5g tid) and high (2g tid) doses of powdered part, aqueous extract combined with oral hypoglycemic agents in type-2 diabetic patients whose diabetes is not controlled by these agents and alcoholic extract of *Azadirachta indica* shows significant hypoglycemic activity in high dose which can be successfully utilized (Kavishankar, 2011). Oral administration of 2.5 and 5.0 g/kg body weight of the aqueous extract of the seed for 6 weeks resulted in significant reduction in blood glucose but in the case of 7.5 g/kg body weight the effect is not significant. Thus the

study showed that *Syzigium cumini* seed extract has hypoglycemic action (Kavishankar, 2011). Another study showed that about 10g of the leaves and (Sirukurinjan) Gymnema sylvestre in (1:1) ratio were boiled in 500mL of water till it reduced to about 50mL. The filtered extract was then given along with 5g of jiggery daily for two months. The fruit pulp (5g) or dried powder (1-2g) was given twice a day for 15 days. However, the seed powder (1-2g) given twice daily is more effective than the fruit (Kumar, 2011).

At a dose of *Ficus bengalensis* 100 mg/kg for one month, there is significant decrease in blood and urine sugar, certain lipid components in serum, tissues and glucose-6-phosphatase activity in liver, but increase in body weight, the activities of hexokinase and HMG-COA reductase in tissues as compared to diabetic control. The mechanism of action of the principle may be related to its protective/inhibitory action against the insulin degradative processes (Kavishankar, 2011). According to the other study shows that an infusion of the bark (10 g) mixed 5g jaggery is an effective and specific medicine for diabetes. This should be given once daily for 10 15 days to reduce blood sugar. The laticiferous sap of this tree is also effective in controlling the diabetes (Kumar, 2011).

Momordica charantia is commonly known as vegetable insulin. An oral sucrose tolerance test reveals that administration of aqueous extract (AE), methanol fraction (MF) or methanol insoluble fraction (MIF) each significantly suppresses plasma glucose levels at 30 min as compared with control. In addition, the plasma insulin level at 30 min also lowers after MF administration than the control in the oral sucrose tolerance test, these results demonstrates that bitter melon suppresses

postprandial hyperglycemia by inhibition of α-glucosidase activity (Kavishankar 2011). On the study shows that decoction of the fruits is given to the patients in the morning in empty stomach at least for one month. The patient is also advised at least for one month. The patient is also advised to take the fruit as vegetable in his/her daily diet. A mixture of Naval (*Syzgium cumini*), Sirukurinjan (*Gymnema sylvestre*), Vembu (*Azadirachta indica*) and Karavellam leaves (Acacia nilotica) in the ratio 1:1; 1:2 is an effective remedy for diabetes (Kumar, 2011). According to another study, this study suggested that administration of the fresh juices of bitter gourd could treat all symptoms of diabetes including polyurea, polydipsia and polyphagia. Urinary excretion of sugar was also reduced and insulin injections were stopped. The seed also possesses hypoglycaemic and hypolipidaemic potential. The hypoglycaemic effect of it could be due to either: 1) depression of key gluconeogenic enzymes or the increase in the levels of glucose transporters and stimulation of glucose uptake in skeletal muscle cells; 2) or preserving the structure and function of islet ß cell, which could result in a significant increase in insulin secretory activity (Bastaki, 2005).

After that the study explores to find out how the Ayurvedic drug had a role to prevent complication. Normal HbA1c determined the status of the sugar control that an indicator of healthy person who had no complications. The study revealed that in male after three months treatment using single medication, the result of RBS in control group had 11.32 mmol/L, Mathi group had 8.88 mmol/L, jam beez group had 8.93 mmol/L, corolla group had 8.96 mmol/L, Bot group had 9.19 mmol/L, neem group had 9.23 mmol/L, tejpata group had 9.40 mmol/L, and synthetic group had 8.75 mmol/L. Moreover, in female, after three months treatment using single medication, the RBS of group-A had 6.70 mmol/L, group-B had 11.33 mmol/L, group-C had 8.98 mmol/L,

group-D had 9.03 mmol/L, group-E had 9.09 mmol/L, group-F had 9.19 mmol/L, group-G had 9.28 mmol/L, group-H had 9.47 mmol/L, group-I had 8.90 mmol/L.

On the other hand, after three months treatment with combine Ayurvedic drug among male subjects, the RBS of group-A had 5.58 mmol/L, group-B had 9.23 mmol/L, group-C had 8.73 mmol/L and group-D had 8.23 mmol/L. Moreover, after three months treatment with combine Ayurvedic drug among female subjects, the RBS of group-A had 5.58 mmol/L, group-B had 9.23 mmol/L, group-C had 8.69 mmol/L and group-D had 8.13 mmol/L. All drugs had better efficacy and complication was reduced by the treatment of Ayurvedic medicine.

This study sought to identify the efficacy of Ayurvedic drugs who attend the private chamber for seeking healthcare. The present study also proved that, single Ayurvedic drug shown the desired pharmacological action by which the blood glucose level and the urine sugar level became low. The single Ayurvedic drug likewise acts on the B- cell of the pancreas to release the insulin; in compilation with the combined Ayurvedic drug the 2nd one provides the effective with its desired pharmacological action. Resent study proved that the single drugs like *Trigonella foenum-graecum* (mathi), *Syzygium cumini* (jam beez), *Ficus benghalenisis* (bot), *Azadirecta indica* (neem), *Cinnamomum tamala* (Tejpata) shows the desired pharmacological action in descending order. Now harshly it can be said that both the Ayurvedic combined and the single drug work well on the β-cell of the pancreas of human body thus lower the glucose level. It was found that there was no statistically significant difference at the end of 12 weeks in the test group, whereas the statistically significant difference in *HbA1c*.

6. CONCLUSION

Metabolic imbalance causing diabetes mellitus is a characteristic of materialistic world. Differences in social structure, psychic stress, obesity, hormonal imbalance and heredity are optimizing the growth of pandemic. Increasing population with diabetes has a huge requirement of effective remediation. The Bangladeshi flora has a vast variety of medicinal plants, which are used traditionally for their anti-diabetic property. However, careful assessment including sustainability of such herbs, ecological and seasonal variation in the activity of phyto-constituents, metal contents of crude herbal anti-diabetic drugs, thorough toxicity study and cost effectiveness is required for their popularity. These efforts may provide treatment for all and justify the role of novel traditional medicinal plants having anti-diabetic potentials.

In the present study, it was observed that the test drug is effective for the treatment of diabetes mellitus, as it reduced blood sugar fasting and blood sugar postprandial. It also gives a valuable relief in clinical symptoms of diabetes mellitus like polyuria, polydipsia, polyphagia, nocturia, tiredness, numbness, cramps and burning sensation in palms/soles. The result of the study shows the evidence of effectiveness of Ayurvedic medicine. Among the respondents, both Ayurvedic and synthetic drug had better efficacy. Ayurvedic drug may prevent further complications of Diabetes mellitus like peripheral neuropathy.

In spite of the overwhelming influence and the dependence on modern medicine and tremendous advances in synthetic drugs, many people still rely on Ayurvedic drugs the reason is that, if the Ayurvedic medicines are used properly they don’t have any side effects. The most important purpose is not to be prescribing any remedies for any of the disease but to be documented the use and draw the attention of pharmacologist, botanist and phytochemist for further scientific research in the field.

7. REFERENCE

Achrekar, S., G.S. Kaklaji, M.S. Pote and S.M. Kelkar. 1991. “Hypoglycemic activity of *Eugenia jambolana* and *Ficus bengalensis*: mechanism of action”. *In vivo*, **5**: 143-147.

Agrawal D.P. 2003. “Diabetes and Traditional Medicine: New research.” www.infinityfoundation.comjt_esj t_es_agraw_diabetes.htmkllllkk.

Ahmed I., M.S. Ahmed, M. Gillett, A. John, H. Raza, 2001. “Hypotriglyceridemic and hypocholesterolemic effects of anti-diabetic *Momordica charantia* (karela) fruit extract in streptozotocin-induced diabetic rats.”

Aiyer, K.N. 1960. Pharmacognosy of Ayurvedic Drugs. 1st Edn., University of Kerala.

Alarcon-Aguilara F.J., 2011. Roman-Ramos R., Perez-Gutierrez S., Aguilar-Contreras A., Contreras-Weber C.C. volume **5**(2).

American Diabetes Association (ADA), Nov-2005. “Assessment of direct patient cost of managing diabetes mellitus at the Komfo Anokye Teaching Hospital”, Kumasi Ashanti Region, Ghana Yeboah, Juliana Abena 3-Nov-2005 3843

Amorin, A.D., H.R. Borba, J.P. Carauta, D. Lopes and Aswini Kumar Dixit and Sudurshan M. 2011. “Review of Flora of Anti-Diabetic Plants of Puducherry UT" Volume **2**(4).

Aswini Kumar, Dixit and Sudurshan M. 2011. "Review of Flora of Anti-Diabetic Plants of Puducherry UT" Volume: **2**: Issue-4.

Augusti, K.T., 1975. "Hypoglycaemic action of bengalenoside, a glucoside isolated from *Ficus bengalensis* Linn, in normal and alloxan diabetic rabbits." *Indian J. Physiol. Pharmacol.,* **19**: 218-220. PMID: 1223001.

Augusti, K.T., R.S. Daniel, S. Cherian, C.G. Sheela and C.R. Nair, 1994. "Effect of leucopelargonin derivative from *Ficus bengalensis* Linn. on diabetic dogs." *Indian J. Med. Res.,* **99**: 82-86. PMID: 8005644.

Ayesha Noor, Vinay S. Bansal I. and M. A. Vijayalakshmi I, 2013. "Current update on anti-diabetic biomolecules from key traditional Indian medicinal plants". *Current Science*, Vol. **104**, No. 6.

Ayurveda, 2003. "A brief introduction and guide", by Vasant Lad, B.A.M.S., M.A.Sc cited.

Bastaki S. 2005. "Diabetes mellitus and its treatment". *Int J Diabetes and Metabolism* **13**: 111-134.

Bhatia I.S., Bajaj K.L. 1975. "Chemical constituents of the seeds and bark of *Syzygium cumini*". *Planta Medica* **28**: 346-352.

Chakraborty Usha and Hariswami Das 2010. "Antidiabetic and Antioxidant Activities of *Cinnamomum tamala* Leaf Extracts in Stz-*Treated Diabetic Rats*, 2010". *Global Journal of Biotechnology and Biochemistry.* **5**(1): 12-18, 2010 ISSN 2078-466X © IDOSI Publications, 2010.

Deshmukh, V.K., D.S. Shrotri, and R. Aiman, 1960. “Isolation of a hypoglycemic principle from the bark of *Ficus bengalensis* Linn. A preliminary note”. *Ind. J. Physiol. Pharmacol.,* **4**: 182-185. PMID: 13722174.

Diabetes Among African Americans. National Diabetes Information Clearinghouse.

Disparities in incidence of diabetic end-stage renal disease by race and type of diabetes. *New England J. Med.* **321**: 1074-1079.

Flores-Saenz J.L., 1998. “Study of the hypoglycemic effect of plants used as anti-diabetics”. *J. Ethnopharmacology* **61**: 101-110.

Foster S., 1993. “Medicinal plant conservation and genetic resources: Examples from the temperate northern hemisphere.” *Acta Hort.* **330**: 674-676.

Grover J.K., S. Yadav, V. Vats, 2002. “Medicinal plants of India with anti-diabetic potential.” *J. Ethnopharmacol.* **81**: 81-100.

Grover, J. K. and V. Vats, 2002. “Shifting paradigm from conventional to alternate medicine. An introduction on traditional Indian medicine”. *Asia Pac. Biotech News*, 2001, **5**: 28-32.

Gupta, R., K. G. Bajpai, S. Johri, and A. M. Saxena, 2008. “An over-view of Indian novel traditional medicinal plants with antidiabetic potentials”. *Afr. J. Tradit. Complement. Altern. Med*., **5**: 1-17.

Harris M.I., R. Klein, C.C. Cowie, M. Rowland, D.O. Byrd-Holt, 1998. “Is the risk of diabetic retinopathy greater in non-Hispanic African Americans and Mexican Americans than in non-Hispanic whites with Type 2 diabetes: AUS population study”. *Diabetes Care* **21**: 1230-1235.

Hongxiang Hui, George Tang, and Vay Liang W. Go. VLW. 2009. “Hypoglycemic herbs and their action mechanisms”. *Chin Med* . **4**: 11-14.

Husain, A. 1992. “Dictionary of Indian Medicinal Plants. 1st Edn., Central Institute of Medicinal and Aromatic Plants, Lucknow”, *India*, pp: 546. *Indian J. Pharmacol*, **38**: 271-5. DOI:10.4103/0253-7613.27024.

Iqbal, Z., Q.K. Nadeem, M.N. Khan, M.S. Akhtar and F.N. Waraich, 2001. “*In vitro* anthelmintic activity of *Allium sativum*, *Zingiber officinale*, *Curcurbita mexicana* and *Ficus religiosa*”. *Int. J. Agric. Biol.*

Ivorra M., Paya M., Villar A., 1988. “Hypoglycemic and insulin release effect of tormentic acid: Anew hypoglycemic natural product.” *Planta Medica* **54**: 282-286.

Janardhan, S. and Y. Padmanabha Reddy, 2011. “Homology modeling and molecular docking studies of human DPP8 and DPP9.” *Int. J. Pharma Res. Dev.*, **12**: 131-146.

Johnston A., 1987. “Plants and the Blackfoot”. Occasional Paper No. 15. Lethbridge Historical Society, Historical Society of Alberta, Alberta, Canada, 55 pp.

Kaplan M.A., 1999. "Anthelmintic activity of the latex of *Ficus* species. *J. Ethnopharm*., **64**: 255-8. DOI: 10.1016/S0378-8741(98)00139-1.

Kavishankar GB, N. Lakshmidevi, S. Mahadeva Murthy, H.S. Prakash, S.R. Niranjana 2011. "Diabetes and medicinal plants-A review". *Int J Pharm Biomed Sci* **2**(3): 65-80 ISSN No: 0976-5263.

Kerala, Gabhe, S.Y., P.A. Tatke and T.A. Khan. 2006. "Evaluation of the immunomodulatory activity of the methanol extract of *Ficus benghalensis* roots in rats."

Kumari, K., B.C. Mathew and K. T. Augusti, 1995. "Antidiabetic and hypolipidemic effects of S-methyl cysteine sulfoxide isolated from *Allium cepa* Linn." *Indian J. Biochem. Biophys*., **32**: 49-54.

Lakshmi Chandra Mishra, 2003. "Scientific basis for Ayurvedic therapies CRC" PRESS Boca Raton London New York Washington, D.C.

Lolitkar M.M., M.R.R. Rao, 1966. "Pharmacology of hypoglycemic principle isolated from the fruits of *Eugenia jamboJana* Linn." *Indian J. Pharmacy* 28: 129-133.

Maiti R., D. Jana, U.K. Das, Ghosh D. 2004. "Antidiabelic effect of aqueous extract of seed of *tamarindus indica* in streptozotocin induced diabetic rats." *J Ethnopharmacol.* **92**: 85-91.

McCune L.M., Johns T., 2002. "Antioxidant activity in medicinal plants associated with the symptoms of diabetes mellitus used by the indigenous peoples of the North America boreal forest." *J. Ethnopharmacol.* **82**: 197-205(a).

McCune L.M., T. Johns, 2002. “Antioxidant activity in medicinal plants associated with the symptoms of diabetes mellitus used by the indigenous peoples of the North America boreal forest.” *J. Ethnopharmacol.* 82: 197-205 NOIC.2003. (B)

Megha Doshi, Anissa Mirza, Balkrishna Umarji, Rohini Karambelkar 2012. “Effect of *Trigonella foenum-graecum* (Fenugreek/Methi) on Hemoglobin Levels in Females of Child Bearing Age” *Biomedical Research.* **23** (1): 47-50.

Menakshi Bhat, Sandeepkumar K. Kothiwale, Amruta R. Tirmale, Shobha Y. Bhargava and Bimba N. Joshi 2011. “Antidiabetic Properties of *Azardiracta indica* and Bougainvillea spectabilis, In Vivo Studies in Murine Diabetes Model volume 2011, Article ID 561625, 9 pages doi: 10.1093/ecam/nep 033, March 2009.

Miura T., Itoh Y., Iwamoto N., Kato M., Ishida T., 2004. “Suppressive activity of the fruit of *Momordica charantia* with exercise on blood glucose in Type 2 diabetic mice”. *Biol. Pharm. Bull.* 27: 248-250.

Miura T., Itoh C., Iwamoto N., Kato M., Kawai M., Park S.R., Suzuki I., 2001. “Hypoglycemic activity of the fruit of the *Momordica charantia* in Type 2 diabetic mice”. *J. Nutr. Sci. Vitaminol. (Tokyo),* 47(5): 340-344.

Mohammad. Lemhadri A., Jouad H., Michel J., Eddouks M., 2003. “Effect of the desert plant *Retama* raetam on glycaemia in normal and streptolotocin-induced diabetic rats.” *J. Ethnopharmacol.* **87** (2004): 21-25.

Mousa, O., P. Vuorela, J. Kiviranta, S.A. Wahab and R. Hiltohen 1994. "Bioactivity of certain Egyptian *Ficus* species." *J. Ethnopharm*., **41**: 71-76. DOI: 10.1016 /0378-8741(94)90060-4

Mukherjee, P.K., K. Saha, T. Murugesan, S.C. Mandal and M. Pal 1998. "Screening of antidiarrhoeal profile of some plant extracts of a specific region of West Bengal, India." *J. Ethnopharm.*, **60**: 85-89. DOI: 10.1016/S0378- 8741 (97) 00130-X.

Mukherjee, P. K., Maiti, K., Mukherjee, K. and Houghton, P. J., 2006. "Leads from Indian medicinal plants with hypoglycemic potentials." *J. Ethnopharmacol*., **106**: 1-28.

Nasim, S. A., B. Dhir, F. Samar, K. Rashmi, and M. A. Mahmooduz-zafar, 2009. "Sulphur treatment alters the therapeutic potency of alliin obtained from garlic leaf extract." *Food Chem. Toxicol*., **47**: 888-892.

Pepato M.T., D.M. Mori, A.M. Baviera, J.B. Harami, R.C. Vendramini, I.L. Brunetti, 2005. "Fruit of the jambolan tree *(Eugenia jamboJana* Lam.) and experimental diabetes." *J. Ethnopharmacol*. **96**: 43-48.

Ravi K., K. Sivagnanam, S. Subramanian, 2004. "Anti-diabetic activity of *Eugenia jambolana* seed kernels on streptozotocin-induced diabetic rats." *J. Med. Food.* 7, 187-191. Res. Clin. Pract. 51, 155-61.

Saravanan, G. and P. Ponmurugan 2010. "Beneficial effects of S-allylcysteine (SAC) on blood glucose and pancreatic antioxidant system in streptozotocin diabetic rats". *Plant Foods Hum. Nutr.*, **65**: 374-378. 725.

Saxena, A. and Vikram, N. K. 2004. “Role of selected Indian plants in management of type 2 diabetes: a review.” *J. Altern. Complement. Med*., **10**: 369-378.

Saxena, A.M., Mukherjee, S.K. and Shukla, G. 2006. “Progress of diabetes research in India during 20th century.” *National Institute of Science and Communication (CSIR),* New Delhi, pp. 1-104.

Sharma Serasinghe P., H. Yamazaki, K. Nishiguchi, F. Hombhanje, S. Nakanishi, 2003. “Oral hypoglycemic effect of *Salacia reticulate* in the streptozotocin induced diabetic rat.” *Phytother. Res.* **4**: 205-206.

Shrotri, D.S. and R. Aiman 1960. “The relationship of the post-absorptive state to the hypoglycemic action studies on *Ficus bengalensis* and *Ficus glomerata*.” *Ind. J. Med. Res.,* **48**: 16-168. PMID: 14446232.

Subbulakshmi G., Naik M. 2001. “Indigenous foods in the treatment of diabetes mellitus.” *Bombay Hospital Res. J.* **43**: 548-61.

Subramanian, P.M. and G.S. Misra 1978. “Chemical constituents of *Ficus bengalensis*. Polish”. *J. Pharma. Pharma.,* **30**: 559-562. PMID: 740556.

Taur, D.J., S.A. Nirmal, R.Y. Patil and M.D. Kharya. 2007. “Antistress and antiallergic effects of *Ficus bengalensis* bark in asthma.” *Nat. Prod. Res.,* **21**: 1266-1270. DOI: 10.1080/14786410701757330 PMID: 18075889.

Vats V, Yadav S.P., Grover J.K., 2003. “Effect of *Trigonella foenum graecum* on glycogen content of tissues and the keyenzymes of carbohydrate metabolism.” *J. Ethnopharmacol.* **85**: 237-242.

Vats V. Grover J.K., Rathi S.S., 2002. "Evaluation of antihyperglycemic and hypoglycemic effect of *Trigonella foenumgraecum, Ocimum sanctum,* and *Pterocarpus marsupium* in normal and alloxanized diabetic rats." *J. Ethnopharmacol.* **79**: 95-100.

Vuksan V., M.P. Stavro, J.L. Sievenpiper, U. Beljan-ldravkovic, L.A. Leiter, R.G. Josse, I. Xu, 2000. "Similar postprandial glycemic reductions with escalation of dose and administration time of American ginseng in Type 2 Diabetes." *Diabetes Care* **23**: 1221-1225.

Wadkar KA, Magdum CS, Patil SS, Naikwade NS. 2008. "Antidiabetic potential and Indian medicinal plants." *J Herbal Med and Toxicol*, **2**: 45-50.

Warrier, P.K., V.P.K. Nambiar and Ramankutty C. 1996. "Indian Medicinal Plants: A Compendium of 500 Species." 1st Edn., Orient Blackswan, Madras, ISBN: 8125007636, pp: 592.

Welihinda J, 1982. Arvidson G, Gylfe E, Hellman B, Karlsson E.Ada Biol MetLGer.