Anti-Diabetic Potential of Polyhrbal Formulations Herbino Herbal Diabetes Capsule, Madhumeh Arogya Amrit Plus Tablet, Sugcare Tablet and SMB Capsule

Abhishek Raj[1], Dr. Amrita Singh[2], Dr. Bhanu P. S. Sagar[3]

IEC Department of Pharmacy, IEC College of Engineering & Technology, IEC Group of Institutions, Greater Noida, Gautam Budha Nagar, Uttar Pradesh, India
Corresponding Author: Abhishek Raj

Abstract
In the present investigation an attempt has been made to comparison of Comparison of antioxidant and anti-diabetic and potential of polyherbal formulations Herbino Herbal Diabetes Capsules, Ayush 82 Madhumeh Arogya Amrit Plus Tablet, SugCare Tablet and SMB Capsules against STZ induced diabetic rats. HHDC contains 75 Phytoconstituents which are derived from 11 medicinal plants / earth crust whereas AMAAPT contains 30 SPMs from 04 natural herbs / minerals, SCT which contains 39 SPMs from 05 natural herbs / minerals and SMBC contains 65 SPMs from 08 natural herbs / minerals. HHDC and SMBC found to be more scientific anti-diabetic polyherbal formulation in comparison of AMAAPT. HHDC, SMBC, AMAAPT and SCT produced anti-diabetic results when compared with toxic control. Further, it was found that HHDC and SMBC induced prominent hypolipidemic / hypocholesterolemic activity but lesser than Standard drug. Beneficial effect of HHDC, AMAAPT, and SMB Capsule on HDL level in treated animals was therapeutic. Beneficial effect (LDL alleviating effect) of HHDC, SMBC and Standard on LDL level in treated groups was good. VLDL alleviating effect of HHDC and SMB Capsule on VLDL level were therapeutically positive. Further, much more elaborated pharmacological research is recommended.

Keywords: Herbino Herbal Diabetes Capsules, Ayush 82 Madhumeh Arogya Amrit Plus Tablet, SugCare Tablet and SMB Capsules, Anti-diabetic, Antioxidant, hypolipidemic / hypocholesterolemic.

Introduction: *Diabetes Mellitus*

Marshal *et al*., 2004, *Diabetes mellitus* (DM) is a metabolic disorder resulting from a defect in insulin secretion, insulin action, or both (endocrine disorder affecting all age groups and having devastating complications) and cover heterogeneous diseases. WHO (2016) has made the prediction that 371 million will be suffering from diabetes in 2030 and India will be Diabetics Capital of the world (95% of total diabetic population is suffering with NIDDM). An estimated 30 million people were diagnosed with diabetes in 1985 all around the world while in 2000 it increased to about 150 million. In 2012 the International Diabetes Federation (IDF) gave an estimation of about 371 million suffering diabetes and it is expected that in 2030 India will be the capital of Diabetics. Pollreisz and Schmidt-Erfurth (2010), oxidative stress is an important factor in pathogenesis of diabetic cataract and retinopathy. Stefek (2011), polyphenol-rich constituents can treat diabetic cataract and diabetic retinopathy. Liu *et al*., 2004, allopathic drugs used in diabetes include thiazolidinedione, sulphonylureas, biguanides, glucagon-like peptide-1 analogs, dipeptidyl peptidase-IV inhibitors and insulin. Overdoses and prolonged therapy of these drugs resulted in side effects. Mukherjee *et al*., 2009, various medicinal plants and phyoto-formulations are clinically used as anti-diabetic due to their promptly accessibility, complete cure and minimal side effects. Maritim *et al*., 2003, oxidation of glucose is involved in pathogenesis of diabetes complications. Rains and Jain (2011), it enhances glycation of hemoglobin and produces HbA1c. In ethnopharmacology more than 1000 herbs possess anti-diabetic potential (hypoglycemic activity) such as *Combretum micranthum, Elephantopus scaber, Liriope spicata, Syzygium cumini, Asparagus racemosus, Piper nigrum.* Natural drugs are used to

cure diabetes and reduce the risk T2DM.

Felig *et al*., 1995 reported that type 1diabetes always need insulin treatment. Nathan *et al.,* 2009 reported that patients with type 2 diabetes to take one or more medicines (hypoglycemic agents) to control blood sugar (glucose) levels which include.

(i) dipeptidyl peptidase 4 inhibitors (sitagliptin);
(ii) biguanide (metformin);
(iii) glucosidase inhibitors (acarbose);
(iv) sulphonylurea (glibenclamide);

Side effects / unwanted issue, caused by anti-diabetic medicine are as follows:

(i) Sulfonylureas: Stomach upset, hypoglycemia, skin rash, weight gain;
(ii) Biguanides/Metformin: kidney complications, GIT disturbances, dizziness;
(iii) Alpha-glucosidase inhibitors: GIT disturbances, diarrhea and bloating;
(iv) Thiazolidinediones: Obesity, anaemia, liver disease, swelling of ankles or legs;
(v) Meglitinides: hypoglycemia and weight gain;
(vi) Saxagliptin (DPP-4 inhibitors): Pancreatitis, hepatitis, kidney impairment.
(vii) Saroglitazar (PPAR agonists): Gastritis and pyrexia (Osadebe *et al.,* 2014)

Mukherjee *et al*., 2009 illustrated that herbal medicine is currently enjoying a revival in popularity in the west and in many parts of the world. Now a day, various Ayurvedic formulations / herbal formulations / phyotoformulations are commercially available for the prevention and treatment of type-2 diabetes. Dwivedi *et al.,* 2013, complementary and Alternative Medicines (CAM) have been used to cure diabetes (up to 72.8%) during last decades. Dwivedi *et al.,* 2013, had found that medicinal plants / formulations induce Anti-diabetic activities through following mechanisms:

i. Stimulation of insulin secretion from beta cells
ii. Increasing the size and number of cells in the islets of Langerhans
iii. Inhibition of insulin degradative processes
iv. Stimulation of glycogenesis and hepatic glycolysis
v. Adrenomimeticism; pancreatic beta cell potassium channel blocking;
vi. Prevention of pathological conversion of starch to glucose
vii. Regenerating and /or repairing pancreas
viii. Protective effect on cells
ix. Reduction in insulin resistance
x. Inhibition in renal glucose re-absorption
xi. Improvement in digestion along with reduction in blood sugar and urea
xii. Inhibition of alpha-amylase
xiii. Cortisol lowering activities
xiv. Inhibition of β -galactocidase and α–glucocidase
xv. Providing calcium, zinc, magnesium, manganese and copper to beta-cells
xvi. cAMP (2nd messenger) stimulation

Herbal Drugs for Treatment of Diabetes Mellitus

Grover *et al*., 2002 revealed that in India unconventional medicines / natural medicines are used to cure diabetes. Rao *et al*., 2010, had reported that in ethnopharmacology more than 100 plants possess significant anti-diabetic potential. Cooper *et al.,* 2012 illustrated that phytochemicals reduce the risk T2DM (anthocyanins and polyphenols). They activate insulin receptors and stimulate insulin secretion from the pancreas. Some medicinal plants possessing hypoglycemic activity through established mechanism such as *Combretum micranthum, Elephantopus scaber, Liriope spicata, Syzygium cumini, Asparagus racemosus, Piper nigrum* (Modak *et al*., 2007). Debjit *et al.*, 2009 had described that herbs are the mines of useful drugs. Traditional medicines are generally considered safe.

Herbino Herbal Diabetes Capsules

Herbino Herbal Diabetes capsules contains 10 natural herbs & Shilajit and it revitalizes the body (tone up pancreas; increases resistance power), optimize carbohydrate metabolism (Table 1).

Table 1 : Herbino Herbal Diabetes Capsules Composition.

S. No.	Botanical Name	Hindi
Each 500 mg Capsule contains:		
1.	*Asphaltum punjabinum*	Shilajit (40 mg)
2.	*Pterocorpus marsupium*	Vijayasar (120 mg)
3.	*Gymnema sylvestre*	Gurmaar (90 mg)
4.	*Momordica charantia*	Karela (70 mg)
5.	*Eugenia jambolana*	Jamun (40 mg)
6.	*Trigonella foenumgraecum*	Methi (30 mg)
7.	*Withania somnifera*	Ashwagandha (30 mg)
8.	*Emblica officinalis*	Amla (20 mg)
9.	*Melia Azadirachta*	Neem (20 mg)
10.	*Swertia chirata*	*Chirayata* (20 mg)
11.	*Curcuma longa*	Haldi (20 mg)

Ayush 82 Madhumeh Arogya Amrit Plus Tablet

Formulation is approved by the Ministry of AYUSH and accredited by National Research Development Corporation. GMP Certified Herbal Formulation. Clinically Tested: Ayush 82 Madhumeh Arogya Amrit Plus is clinically tested by Central Council for Research and Ayurvedic Sciences (CCRAS). Made of Natural Ingredients: Ayush 82 Madhumeh Arogya Amrit Plus encapsulates the benefits of natural herbs like Gudmar, Jamun, Karvella, Mango Seeds and Amla clinically proven to control blood sugar levels. A natural, thoroughly tested, and specially formulated medicine called Ayush 82, Madhumeh Arogya Amrit Plus helps regulate blood sugar levels. It is entirely made of natural ingredients, so it has no negative effects on our body like allopathic medicines, which only concentrate on forcefully lowering the blood sugar level (Table 2).

Table 2 : Ayush 82 Madhumeh Arogya Amrit Plus Tablet Composition.

S. No.	Botanical Name	Hindi
Each 500 mg Tablet contains:		
1.	*Gymnema sylvestre*	Gudmar
2.	*Eugenia jambolana*	Jamun
3.	*Mangifera indica*	Mango
4.	*Emblica officinalis*	Amla

SugCare Tablet

An effective ayurvedic treatment for mild to moderate diabetes is Vedical SugCare Tablet. It is based on a combination of herbs, including Amra, Jamun, and Karela, and it works well to relieve diabetes-related symptoms. If taken in synergy for a few weeks, it is safe to use and effective for those with advanced-stage diabetes or high blood sugar. It regulates diabetes and its related issues, works in tandem with allopathic medications, is helpful for mild to moderate diabetes, safe to use in conjunction with allopathy medications, has undergone clinical testing, and is safe (Table 3).

Table 3 : SugCare Tablet Composition.

S. No.	Botanical Name	Quantity (mg)
Each Tablet contains Extracts derived from the following:		
1.	*Quassia amara* (Amara; Wood)	625 mg
2.	*Syzygium cumini* (Jamun; Fruit and Seeds)	625 mg
3.	*Gymnema sylvestre* (Gurmar; leaves)	625 mg
4.	*Asphaltum punjabinum* (Shilajit)	140 mg
5.	*Momordica charantia* (Karela; fruit)	625 mg
Total		2640 mg
Excepients		QS

Nveda SMB Capsules

SMB Capsules has been approved by AYUSH, the Ayurvedic Government Organisation for Blood Sugar Management, and has been certified in accordance with the guidelines and reference of the Indian Ayurvedic Formulary (Table 4).

Table 4 : Nveda Sugar Management & Balance (SMB) Capsules Composition.

S. No.	Botanical Name with Vernacular name (hindi)	Quantity (mg)
Each Tablet contains Extracts derived from the following:		
1.	*Syzygium cumini* (Jamun; Seeds Powder)	50 mg
2.	*Berberis aristata* (Daruharidra; Root Powder)	100 mg
3.	*Gymnema sylvestre* (Gurmar; leaves Powder)	25 mg
4.	*Momordica charantia* (Karela; Seed Powder)	50 mg
5.	*Curcuma longa* (Haridra; Rhizome Powder)	50 mg
6.	*Pterocarpus marsupium* (Vijaysar; Heart-wood Powder)	50 mg
7.	*Azadirachta indica* (Nimba; Stem Bark Powder)	25 mg
8.	*Asphaltum punjabinum* (Sudh Shilajit)	100 mg
9.	Sodium Benzoate	0.25 mg
10.	Magnesium Stearate	0.37 mg
11.	Starch	0.25 mg

Total	450.87 mg
Excepients	QS

So, the present investigations have been undertaken with following objectives:

- Comparison of HHDC, AMAAPT, SCT and SMBC on various parameters like active anti-diabetic phytoconstituents, phytopharmaceuticals present, Pharmacological uses, MoA, Side Effects and clinical efficacy.
- Comparison of antioxidant potential of HHDC, AMAAPT, SCT and SMBC.
- Comparison of anti-diabetic study of HHDC, AMAAPT, SCT and SMBC in Streptozotocin induced diabetic Wistar Albino Rats

Herbino Herbal Diabetes Capsules (HHDC) contains 75 Phytoconstituents which are derived from 11 medicinal plants / earth crust whereas Ayush 82 Madhumeh Arogya Amrit Plus Tablet (AMAAPT) contains 30 SPMs from 04 natural herbs / minerals, SugCare Tablet (SCT) which contains 39 SPMs from 05 natural herbs / minerals and SMB Capsules (SMBC) contains 65 SPMs from 08 natural herbs / minerals. HHDC and SMBC found to be more scientific anti-diabetic polyherbal formulation in comparison of AMAAPT and SCT.

Detection of PPMs / SPMs

HHDC, AMAAPT, SCT, SMBC polyherbal formulations were used for phytochemical investigations were undertaken using different polar and non-polar solvent extracts. Preliminary phytochemical screening for the detection of various was carried out by using standard procedures described by Harborne, Khandelwal and Practical Pharmacognosy by Kokate. Phytochemical screening (qualitative analysis) of formulations Herbino Herbal Diabetes Capsules, Ayush 82 Madhumeh Arogya Amrit Plus Tablet, SugCare Tablet, SMB Capsules indicated the presence of following PPMs and SPMs (alkaloids Flavanoids; Phenolic Compounds; Terpenoids; Reducing sugars; glycosides; steroids; Phyto sterols, Amino acids; Proteins; carbohydrate etc.)

***In-vitro* Antioxidant effects of Polyherbal Formulations**

In-vitro antioxidant activity of Herbino Herbal Diabetes Capsules, Ayush 82 Madhumeh Arogya Amrit Plus Tablet, SugCare Tablet, SMB Capsules by DPPH, NO radical scavenging method was performed.

DPPH Free Radical-Scavenging Activity: DPPH radical-scavenging capacity was measured by method of Blois (1958).

Nitric Oxide (NO) Scavenging activity: Curcumin was used as Standard. (Larson, 1994)

Antioxidant Activity by Ferric Reducing Antioxidant Power Assay: The FRAP assay was performed as per method of Benzie and Strain (1996).

Reducing Power Assay (Jayaprakasha *et al*., 2001) **:** As per SOP.

Comparative Anti-diabetic study

Animal Study was approved by IAEC meeting (02-11-2024) of IEC-GI as per guidelines provided by CPCSEA (Registration No – 1332/PO/Re/S/10/CPCSEA, Registration Renewal : 11-01-2019) with protocol (Form-B No. IEC/IAEC/2023/09. Albino Rats (male; 200 g) were procured from Head, Central Laboratory Animal Resources, Jawaharlal Nehru University (JNU), New Delhi. Animals were acclimatized, housed in animal house at temperature 25°±2°C, 55±5% humidity and 12 hrs day-night cycle.

Group I (Normal group): rats in this group were given citrate buffer, a vehicle of STZ.

Group II (Toxic Control (STZ + vehicle group): Animals group were induced diabetes mellitus via single injection of STZ and received distilled water or vehicle of the extract.

Groups III-VI (STZ + Polyherbal Formulation): All rats were induced DM with STZ and received Herbino Herbal Diabetes Capsules (500 mg/kg; Group III), Madhumeh Arogya Amrit Plus Tablet (500 mg/kg;

Group IV), SugCare Tablet (660 mg/kg; Group V) and SMB Capsules (450 mg/kg; Group VI).
Groups VII (STZ + glibenclamide (standard). All rats were induced diabetes mellitus with STZ and received glibenclamide (standard; 5 mg/kg).

Action of HHDC, AMAAPT, SCT and SMBC on Blood Glucose Level
Animals were treated with HHDC, AMAAPT, SCT and SMBC and the control group received distilled water. Blood was taken retro orbital plexus under anaesthesia with Ketamine (80-85 mg/kg i.p.) in combination with Xylazine (8-10 mg/kg i.p.) at the end of the fasting period taken as zero time (0 h). Blood glucose levels were determined in 1, 2, and 3 h following treatment and were monitored with the help of Accuchek Glucometer or by GOD/POD method.

Action of HHDC, AMAAPT, SCT and SMBC on Oral Glucose Tolerance Test (OGTT)
Oral glucose tolerance test was performed on overnight fasted normal rats. Healthy rats were divided into 07 groups of 06 animals in each group. The animals were administered HHDC, AMAAPT, SCT and SMBC and the control group received distilled water. Subsequently, animals were given glucose (2 g/kg b.w.) orally, 60 min after dosing. Glucose loading (at 0, 30, 60, 90 and 120 min) and blood glucose levels were estimated.

Comparison of Anti-diabetic effect of HHDC, AMAAPT, SCT and SMBC
Diabetes was induced using Strepzotocin (Himedia Laboratories Pvt. Ltd., Mumbai) (60mg/kg i.p. in 0.1M citrate buffer (pH = 4.5). After 07 days of STZ injection, (taken as 0^{th} day) fasting blood glucose levels of each animal were analyzed. Animals having fasting sugar more than 200 mg/dl were used. All animals were given free access to pellet diet and randomly assigned into five groups of six animals each. Animals were given treatment as per protocol groups. After 21 days oral administration Diabetes Capsules (Herbino Herbal; Group III), Madhumeh Arogya Amrit Plus Tablet (Ayush 82; Group IV), SugCare Tablet (Group V), SMB Capsule (Group VI), Glipizide - Standard Drug (Group VII) blood glucose levels were determined.

Effect of Polyherbal formulations on Lipid Profile in diabetic rats.
High Density Lipoprotein (LDL) : Friedwald *et al.,* 1972 method was used.
VLDL : Friedewald *et al.,* 1972 illustrated VLDL.

Results and Discussions
Present research work was started with procurement of polyherbal formulation Herbino Herbal Diabetes Capsules (HHDC), Ayush 82 Madhumeh Arogya Amrit Plus Tablet (AMAAPT), SugCare Tablet (SCT), Nveda Sugar Management & Balance Capsules (SMBC) from the genuine commercial source which include online source and commercial supplier. Their literature were studied and compared. Herbino Herbal Diabetes Capsules (HHDC) contains 75 Phytoconstituents which are derived from 11 medicinal plants / earth crust whereas Ayush 82 Madhumeh Arogya Amrit Plus Tablet (AMAAPT) contains 30 SPMs from 04 natural herbs / minerals, SugCare Tablet (SCT) which contains 39 SPMs from 05 natural herbs / minerals and SMB Capsules (SMBC) contains 65 SPMs from 08 natural herbs / minerals. HHDC and SMBC found to be more scientific anti-diabetic polyherbal formulation in comparison of AMAAPT and SCT. Subsequently, in phytochemical screening of polyherbal formulations HHDC, AMAAPT, SCT and SMBC indicated the presence of alkaloids Flavanoids; Phenolic Compounds; Terpenoids; Reducing sugars; glycosides; steroids; Phyto sterols, Amino acids; Proteins; carbohydrate etc.

Antioxidant (free radical-scavenging) activities of the Herbino Herbal Diabetes Capsules, Ayush 82 Madhumeh Arogya Amrit Plus Tablet, SugCare Tablet, SMB Capsules increased with increasing concentrations (regression equations significant at $p < 0.05$.

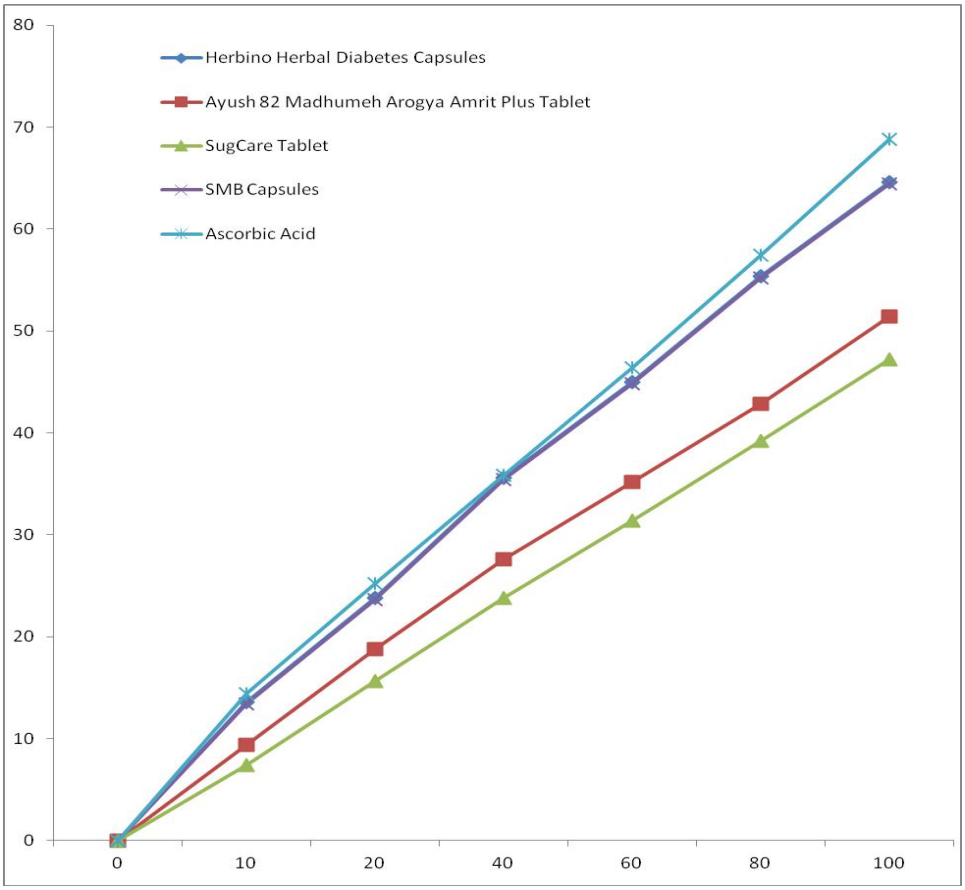

Fig.1: The regression curve of DPPH.

HHDC produced highest NO scavenging activity with IC50 value 94.60 µg/ml. Antioxidant activities by reducing power assay of HHDC, AMAAPT, SCT and SMBC were increased with increased dose. The reducing power of HHDC, AMAAPT, SCT and SMBC increased with increasing dosage (possess free radical scavengers/anti-oxidants activity). The antioxidant activity of HHDC, AMAAPT, SCT and SMBC by FRAP assay was found to be 1080.62±5.26 µmol FeSO4/g DW, 876.46±5.48 µmol FeSO4/g DW and 9.62±5.16 µmol FeSO4/g DW respectively. Antioxidant activity of HHDC, AMAAPT, SCT and SMBC were significant (means±S.D.) and analysis of variance was performed by the ANOVA procedures. All polyherbals formulations produced potent antioxidant activity dose dependently by preventing cell membrane oxidation. Polyphenol, tannins, flavonoids and bitter principles in HHDC, AMAAPT, SCT and SMBC induced antioxidant activity through significant superoxide radical scavenging activity, inhibition of oxidation. HHDC, AMAAPT, SCT and SMBC have produced significant glucose lowering effect after 2 hr of treatment. Sugar levels were restored after 3 hr in all treatment groups. HHDC, AMAAPT, SCT and SMBC had alleviated glucose level ($P < 0.001$). Herbino Herbal Diabetes Capsules (HHDC) and SMB Capsule produced better action than Ayush 82 Madhumeh Arogya Amrit Plus Tablet, SugCare Tablet and in toxic control group. Further, it was observed that HHDC, SMBC, AMAAPT and SCT had significant glucose lowering effects and maximum reduction was observed after 21 days of the treatment. HHDC, SMBC, AMAAPT and SCT produced anti-diabetic results when compared with toxic control (Fig. 2-4).

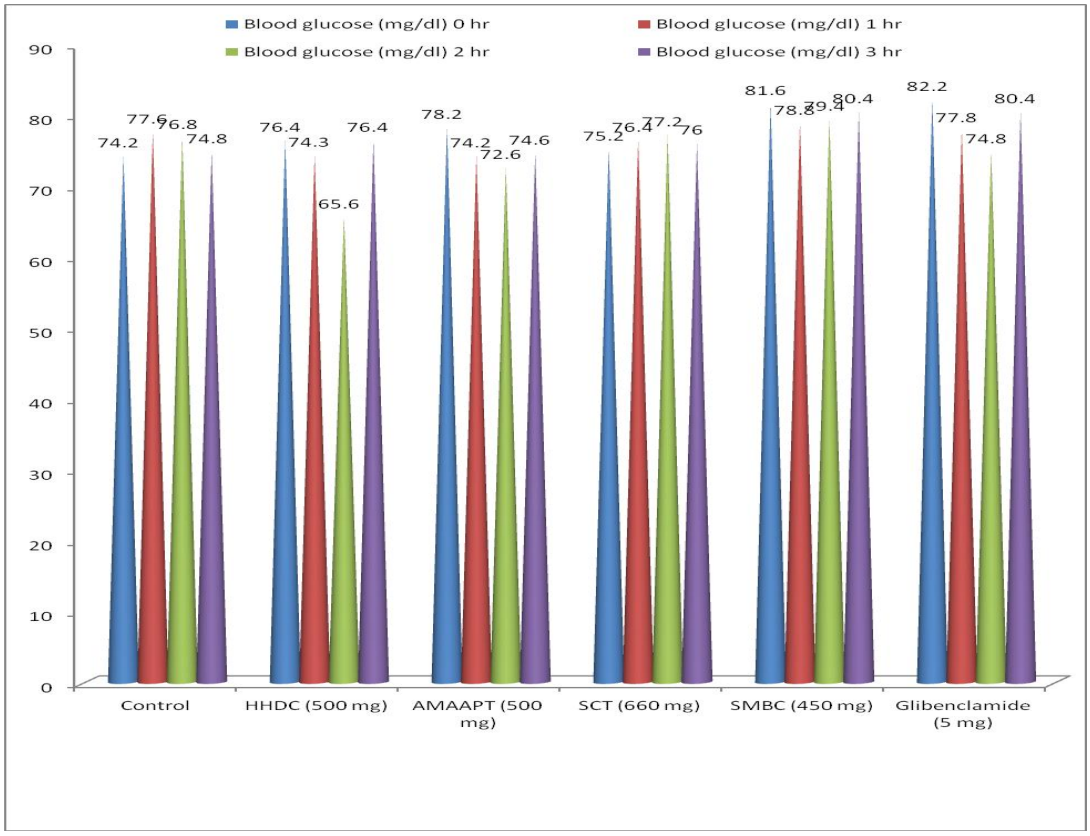

Fig. 2 : HHDC, AMAAPT, SCT and SMBC action on blood glucose.

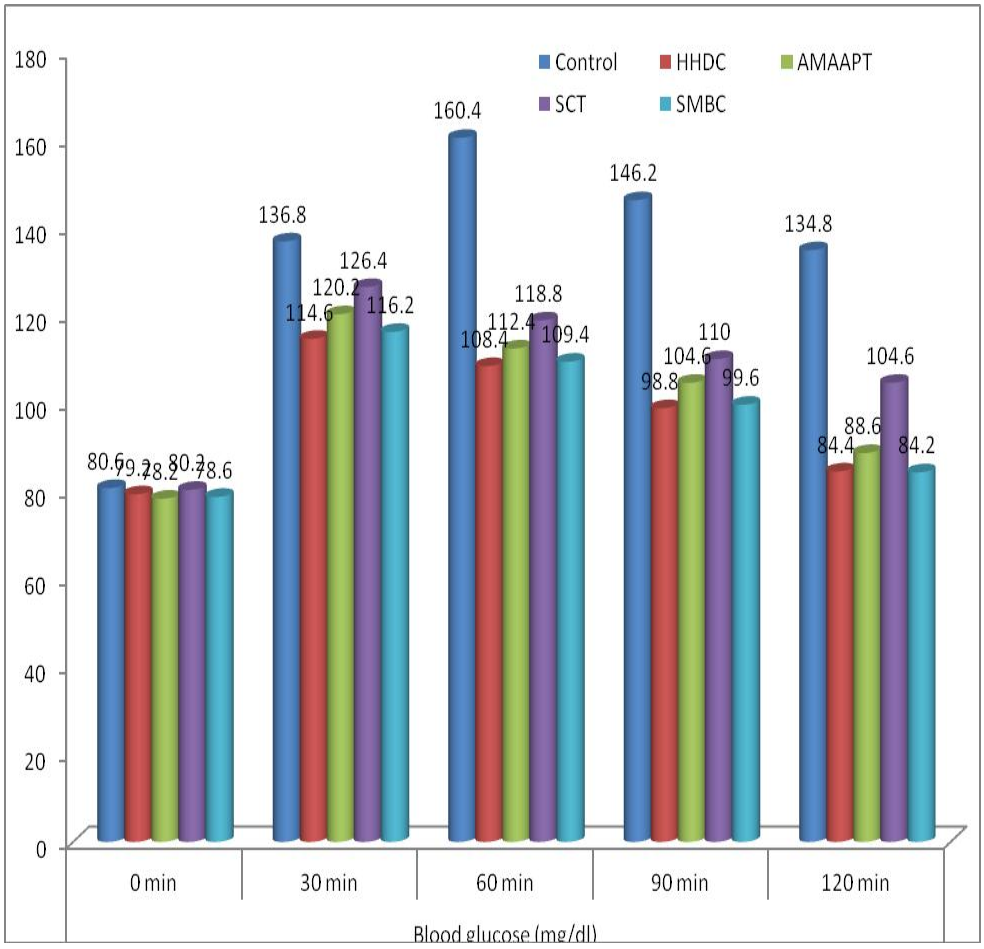

Fig. 3 : Effect of HHDC, AMAAPT, SCT and SMBC on glucose tolerance.

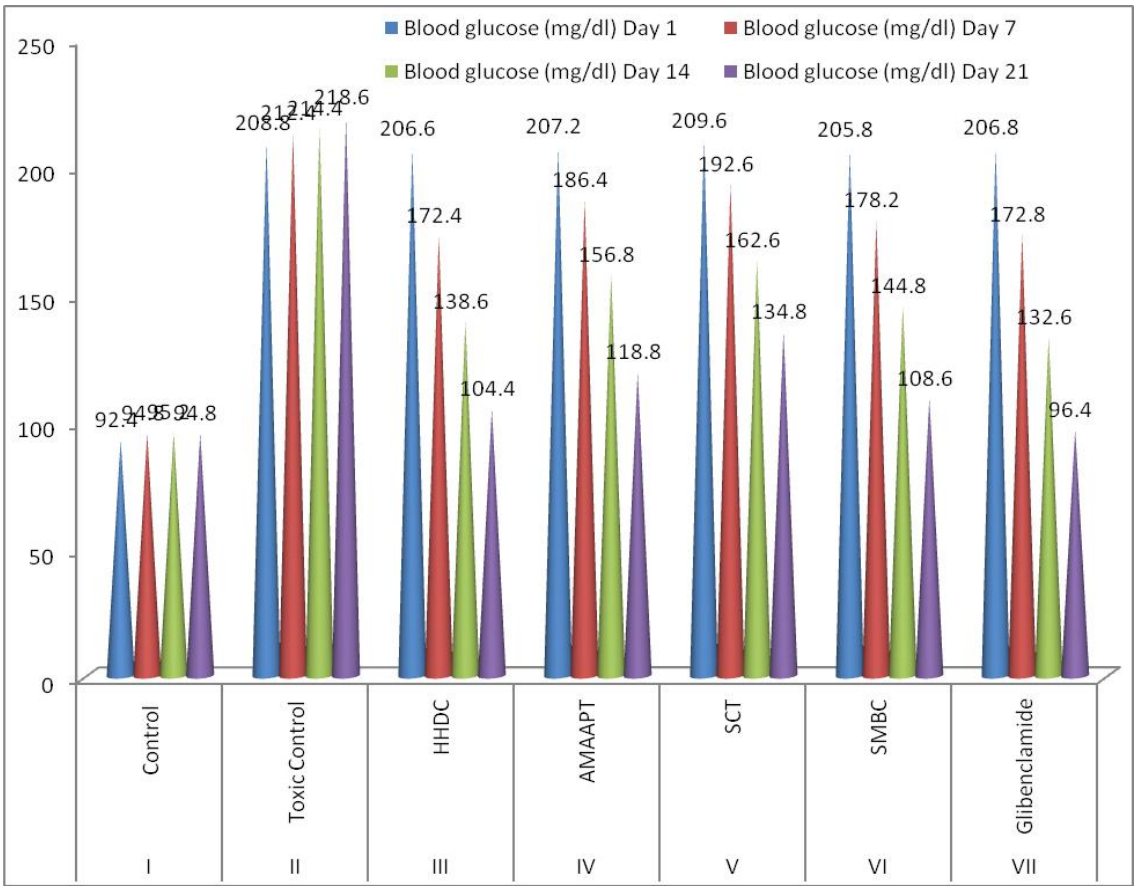

Fig. 4: Effect of HHDC, AMAAPT, SCT and SMBC in STZ induced diabetic rats.

In animals treated with HHDC the blood glucose level was lowered significantly from 206.6 mg/dl (1st day), 172.4 mg/dl (day 7), 138.6 (day 14) to 104.4 (day 21) (Fig. 4). On the other hand, animals treated with SMB Capsule blood glucose was 205.8 (Day-1), 178.2 (day-7), 144.8 (day-14) and 108.6 mg/dl (day-21). Further, in animals treated with AMAAPT blood glucose was 207.2 (Day-1), 186.4 (day-7), 156.8 (day-14) and 118.8 mg/dl (day-21). In animals treated with SCT blood glucose was 209.6 (Day-1), 192.6 (day-7), 162.6 (day-14) and 134.8 mg/dl (day-21). Glibenclamide (reference drug) lowered the blood glucose to 206.8 (Day-1), 172.8 (day-7), 132.6 (day-14) and 96.4 mg/dl (day-21).

Observations recorded in Fig. 5 indicated the effect of HHDC, AMAAPT, SCT and SMBC on cholesterol and triglycerides level in STZ induced diabetic rats. STZ toxicity induced increase in serum cholesterol (after 7 days 264.8; after 21 days 224.2), triglycerides [202.2 (7 days); 178.2 (21 days)] ($P < 0.0001$). HHDC treatment alleviated the level serum cholesterol [140.8 (7days); 120.4 (21 days)], triglycerides [130.2 (7 days); 86.6 (21 days)]. Treatment with SMBC alleviated cholesterol [144.6 (7days); 118.8 (21 days)], triglycerides [130.6 (7 days); 82.8 (21 days)]. Further, treatment with AMAAPT alleviated cholesterol [152.4 (7days); 132.4 (21 days)], triglycerides [146.2 (7 days); 94.2 (21 days)]. Treatment with SCT alleviated cholesterol [186.4 (7days); 156.2 (21 days)], triglycerides [166.4 (7 days); 140.8 (21 days)]. Standard reference drug glibenclamide (5mg/kg) decreased cholesterol the [114.8 (7 days); 96.6 (21 days)], triglycerides [97.4 (7 days); 86.2 (21 days)]. HHDC and SMBC induced prominent hypolipidemic / hypocholesterolemic activity but lesser than Standard drug ($P < 0.0001$).

In normal animals HDL (good cholesterol) level were found to be 61.6 (7 days) and 41.6 (after 21 days). In diabetic control / toxic control group HDL level were 22.4 (7 days) and 28.2 (21 days). HDL was significantly lowered in diabetic rats when compared to normal control ($P < 0.0001$). Herbino Herbal Diabetes Capsules restored HDL level 35.4 (7 days) and 43.4 (21 days) and SMB Capsule treatment the produced HDL level 35.2 (7 days) and 43.8 (21 days). In glibenclamide (5mg/kg) treated group serum HDL

was 39.2 (7 days) and 47.4 (21 days). Beneficial effect of Herbino Herbal Diabetes Capsules, Ayush 82 Madhumeh Arogya Amrit Plus Tablet and SMB Capsule on HDL level in treated animals was therapeutic. (Fig. 6)

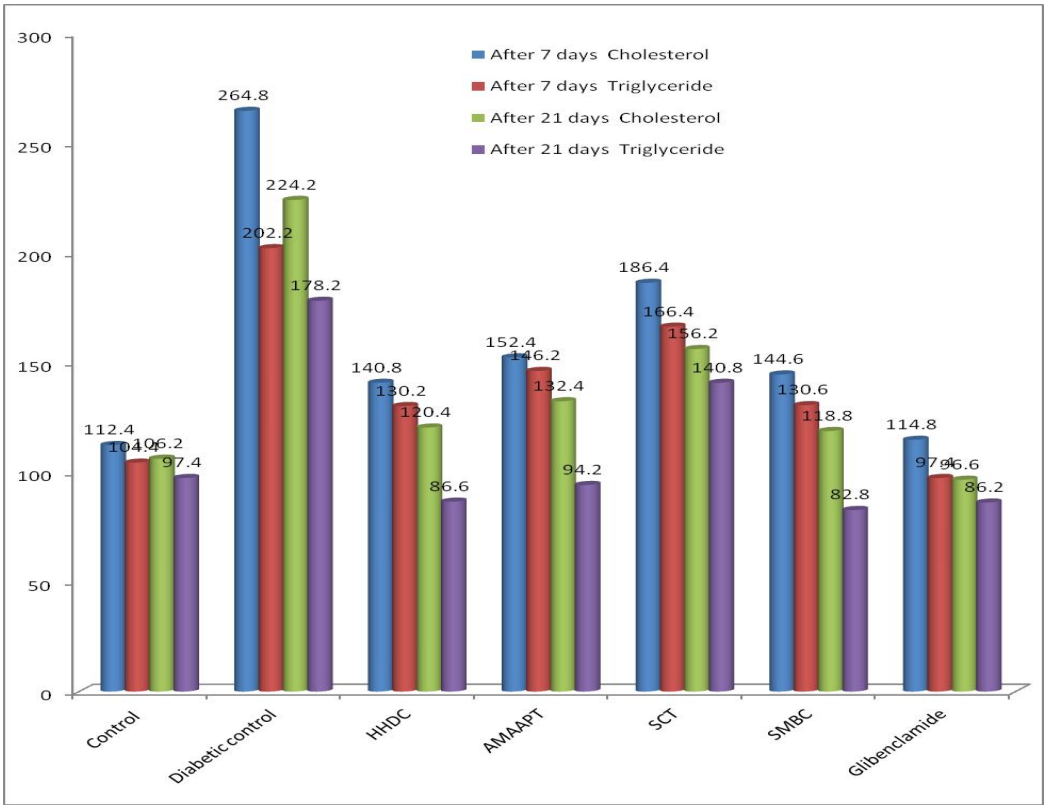

Fig. 5: Effect of HHDC, AMAAPT, SCT and SMBC on cholesterol and triglycerides.

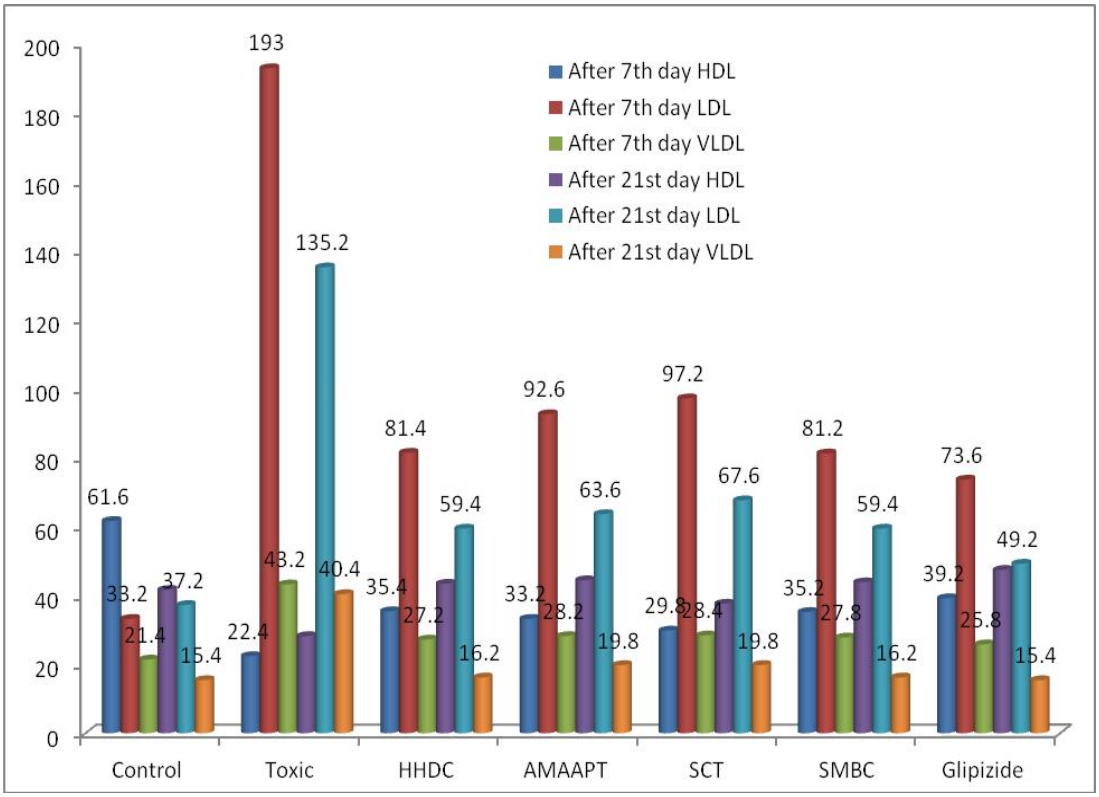

Fig. 6: Effect of extracts on lipoproteins in STZ induced diabetic rats.

In healthy animals (normal group) LDL (bad cholesterol) level were found to be 33.2 (7 days) and 37.2 (after 21 days). In toxic control group LDL level were 193 (7days) and 135.2 (21 days). LDL was significantly increased in STZ toxic group animals ($P < 0.0001$). HHDC alleviated LDL level 81.4 (7 days) and 59.4 (21 days) and AMAAPT treatment the produced LDL level 92.6 (7 days) and 63.6 (21 days). SMBC alleviated LDL level 81.2 (7 days) and 59.4 (21 days).

In glibenclamide treated group serum LDL was 73.6 (7days) and 49.2 (21 days). Beneficial effect (LDL alleviating effect) of HHDC, SMBC and Standard on LDL level in treated groups was good. In normal group VLDL level were found to be 21.4 (7 days) and 15.4 (21 days). In diabetic toxic control group VLDL were 43.2 (7days) and 40.4 (21 days). HHDC alleviated VLDL level 27.2 (7 days) and 16.2 (21 days) and AMAAPT treatment the produced VLDL level 28.2 (7 days) and 19.8 (21 days). SMBC alleviated VLDL level 27.8 (7 days) and 16.2 (21 days). In glibenclamide treated group serum VLDL level was 25.8 (7days) and 15.4 (21 days). VLDL alleviating effect of Herbino Herbal Diabetes Capsules and SMB Capsule on VLDL level were therapeutically positive. (Fig. 6)

Conclusions

In the present investigation an attempt has been made to comparison of Comparison of antioxidant and anti-diabetic and potential of polyherbal formulations Herbino Herbal Diabetes Capsules, Ayush 82 Madhumeh Arogya Amrit Plus Tablet, SugCare Tablet and SMB Capsules against STZ induced diabetic wistar rats. HHDC contains 75 Phytoconstituents which are derived from 11 medicinal plants / earth crust whereas AMAAPT contains 30 SPMs from 04 natural herbs / minerals, SCT which contains 39 SPMs from 05 natural herbs / minerals and SMBC contains 65 SPMs from 08 natural herbs / minerals. HHDC and SMBC found to be more scientific anti-diabetic polyherbal formulation in comparison of AMAAPT. Subsequently, in phytochemical screening of all polyherbal formulations indicated the presence of alkaloids Flavanoids; Phenolic Compounds; Terpenoids; Reducing sugars; glycosides; steroids; Phyto sterols, Amino acids; Proteins; carbohydrate etc**.** Free radical-scavenging activities of the HHDC, AMAAPT, SCT and SMBC increased with increasing concentrations. HHDC produced highest NO scavenging activity. The reducing power of HHDC, AMAAPT, SCT and SMBC increased with increasing dosage. In comparative anti-diabetic study, HHDC and SMBC produced better action than AMAAPT and SCT and toxic control group. HHDC, SMBC, AMAAPT and SCT produced anti-diabetic results when compared with toxic control. Further, it was found that HHDC and SMBC induced prominent hypolipidemic / hypocholesterolemic activity but lesser than Standard drug. Beneficial effect of Herbino Herbal Diabetes Capsules, Ayush 82 Madhumeh Arogya Amrit Plus Tablet and SMB Capsule on HDL level in treated animals was therapeutic. Beneficial effect (LDL alleviating effect) of HHDC, SMBC and Standard on LDL level in treated groups was good. VLDL alleviating effect of Herbino Herbal Diabetes Capsules and SMB Capsule on VLDL level were therapeutically positive.

Acknowledgement

We feel indebted to Management of IEC Group of Institutions for funding this research work. Besides, we express my sincere thanks to Head, Animal House Facility, JNU, New Delhi for providing me animals for my pharmacological research investigations.

References

1. Benzie, I. F. and Strain, J.J. (1996). *Anal. Biochemistry*. 239, pp. 70–76.
2. Blois, M.S. (1958). *Nature.* 181, pp. 1199–1200.
3. Cooper, A.J., Forouhi, N., Ye, Z. (2012). *Eur. J. Clin. Nutr*. 66(10), pp. 1082-1092.
4. Debjit, B., Margret, C., Chiranjib, D. (2009). *Arch. Appl. Sci. Res.*, 1(2), 32-56.
5. Dwivedi, C., Daspaul, S., (2013). *Jour. of Phytopharmacol.* 2(3), pp. 44-51.
6. Felig T.R., Sosenko JM, Ziegler D. (1995). *Diabetes Care*. 28:956-962
7. Friedewald, W. T., Levy, I., Fredrickson, S. (1972). *Clin Chem.* 18(6), 499-502.
8. Grover, J.K., Yadav, S., Vats, V. (2002). *J. Ethnopharmacol.* 81, pp. 81-100.
9. Harborne, J. B. (1973). *Phytochemical Methods.* pp. 1-288.

10. Jayaprakasha, G.K, Singh, P., Sakariah, K. (2001). *Food Chem.* 73, pp. 285-290.
11. Khandewal, K.R. (2008). *Prac. Pharmacognosy*. Nirali, ed.: 19, pp. 1-67.
12. Kokate, C. K. (2005). *Practical Pharmacognosy*. 5th Ed., Prakashan. 107- 111.
13. Larson, RA. (1994). *Phytochemistry*. 27(4), pp. 969-978.
14. Liu, B., Amiel, S.A., Jones, P.M. (2004) *Cell. Physiol. Biochem.* 23, 125–132.
15. Maritim, A.C., Sanders, R.A., Watkins, B. (2003). *J Bio. Mol. Toxi*. 17, 24-38.
16. Marshal, W., S.K. Bangret. (2004). *Clinical Chemistry, Elsevier*, pp. 191
17. Modak, M., Londhe, J., Dixit, P., (2007). *J. Clin. Biochem. Nutr.*, 40, pp. 163–173.
18. Mukherjee, P.K., Narayanan, K., Sahoo, A. (2009). *Exp. Opin. Dis.*4(5),545-576.
19. Nathan, D.M., Sherwin, R., Holman, R. (2009). *Diabetes Care.* 32, 193-203.
20. Osadebe, L., Manthi, K., Damon, K. (2014). *Clin. Infect.* 60(2), pp. 195–202.
21. Pollreisz, A. and Schmidt-Erfurth, U. (2010). *J. of Ophthal.* 8, pp. 10-12.
22. Rains, J.L. and Jain, S.K. (2011). *Free Radic Biol Med*. 50, pp. 567–575.
23. Rao, M., Sreenivasulu, M., Chengaiah, B. (2010). *Int. J. Pharm. Res*. 2(3), 67-78.
24. Stefek, M. (2011). *Interdisc. Toxic.* 4(2), pp. 69-77.
25. World Health Organization. *Global Report on Diabetes*. 2016.