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In vitro Inhibitory Effect on Alpha Amylase Enzyme by Polyherbal Dip Tea in Diabetes

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ABSTRACT: Objective: The present study aims to prepare novel polyherbal formulations in a unique and accessible tea bag form and also analyses the antidiabetic potentials in vitro. **Material and method:** The formulation was made from *Ichnocarpus frutescens(IC), Ficus dalhousiae (FD), Creteva magna (CM), Alpinia galanga (AG) and Swertia chirata (SC)* herbs and used in this study. Indian medicinal plants i.e., polyherbal were subjected to progressive phytochemical analysis and tests were carried out for the determination of α-amylase inhibition activity. The Phytochemical analysis revealed the presence of Alkaloids, Tannins, Anthraquinone, Flavonoids, Saponin and reducing sugar, as the active compounds. The tea infusions of the aforementioned plants were prepared in different formulations like F1, F2, F3, and F4. The formulations were tested for antidiabetic activity *in vitro* through the inhibition of alpha-glycosidase. **Results:** The F3 (91.6%) and F4 (92.7%) showed the higher inhibition data against porcine pancreatic α-amylase among the Four formulations. The minimum % alpha-amylase inhibition was recorded in F2 (90.4%) among the medicinal active plants studied. **Conclusion:** Hyperglycaemia level is reduced via a controllable condition of starch breakdown through pancreatic α-amylase inhibitors. Best results were obtained by the infusion containing The F2 formulation which showed significant antidiabetic activity.

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder, occurring from insulin deficiency characterized by hyperglycaemia, excessive urination i.e., polyuria, glycosuria (glucose as an abnormal constituent in urine), Polydipsia and the metabolism of carbohydrates, proteins and fats are affected. There are four types of Diabetes Mellitus but 2 are major types of diabetes mellitus [1]. Insulin-dependent diabetes mellitus (IDDM) and

Non-insulin dependent diabetes mellitus (NIDDM) [2]. **World statistic of Diabetes** Diabetics is becoming a major challenge to the world population. This is turning into a major threat to public health globally that is rapidly reaching even to an epidemic scale. According to the World Health Organization (WHO) [3] following information are worthwhile to mention here: The population with diabetes has drastically increased from 108 million in 1980 to 422 million in 2014. An estimated 700 million adults worldwide will have diabetes by 2045. The cases have been drastically increasing. Flow range in underdeveloped and developing countries where the health facilities are poor and developing verge is more than in high-income countries. The person suffering from Diabetes show major effects like affected vision, nephropathy, myocardial infarction/heart attacks, stroke and poor wound healing capacity which sometimes led to limb amputation of the patients. The rate of premature mortality due to diabetes was increased to 5% between the years 2000 to 2016, which can be controlled/regulated by a healthy diet, maintaining proper Basal metabolic Index (BMI), regular exercise, and reducing the youths access to the tobacco products [4].

Chronic hyperglycaemia degenerates the β-cells of Langerhans of the pancreas which decreases the production and secretion of insulin; which leads to an increase in the glucose level more than normal which produces insulin resistance. Oxidative stress in different body tissues rises under diabetic conditions and worsens diabetic complications. Oxidative stress-mediated tissue damage majorly targets the pancreatic β-cells. Diabetes can even lead to a profound change in the concentration and composition of lipid. Decreased glucose breakdown (glycolysis), glycogenesis is also delayed and increased in the formation and production of glucose from the non-carbohydrate source i.e., gluconeogenesis is one of the major changes which take place in the diabetic liver [2, 5].

The presently marketed classes of antidiabetic agents produce a variety of actions that can be combined in a supporting and supplementary manner, only a small patient population follows the recommended targets for optimal glycaemic control and normal glucose balance [6]. There are various side effects as listed in (**Table 1**) for synthetic diabetic drugs. This highlights the urgent need for an effective antihyperglycemic agent, particularly which brings the glucose level to normal, helps in the proper functioning of the pancreas and production of insulin at normal range and can also reduce the dose of exogenous insulin by increasing insulin sensitivity in type 1 diabetes patients. Herbal preparations are considered safer and a having fewer side effects when compared to synthetic drugs [7]. Herbal preparations are an emerging good source of new hypoglycaemic agents to develop a new era of pharmaceutical, nutraceutical as well as a health supplement to available remedies. Some of the herbal treatments being used for diabetes have received scientific acceptance and even the health expert committee for diabetes are recommending further consideration [15, 16].

Table 1: Common side effects of the synthetic drugs available in the market [8-14]

Drug	Side effects
Sulfonylureas	Low blood sugar, upset stomach, skin rash or itching, weight gain
Biguanides/Metformin	Sickness with alcohol, kidney complications, upset stomach, tiredness or dizziness, metal taste
Alpha-glycosidase inhibitors	Gas, bloating and diarrhoea
Thiazolidinedione's	Weight gain, risk of liver disease, anaemia risk, swelling of legs or ankles,
Meglitinides	Weight gain, low blood sugar
Insulin	Short shelf life, the requirement of constant refrigeration, overdose-induced hypoglycaemia etc.

As per the Indian traditional system, a blend/mixture of medicinal compounds is employed for better pharmacological activity with low side effects [17]. Considering the above information, the present study is to design and assess the antidiabetic potential of a polyherbal formulation containing a combination of different herbs viz. *Ichnocarpus frutescens* (IC), *Ficus dalhousiae* (FD), *Creteva magna* (CM), *Alpinia galanga* (AG) *and Swertia chirata* (SC), by the in vitro technique of α- amylase inhibition activity.

Tea-bag novelty

As the socio-economic status of the population and culture is increasing, there is an increasing demand for tea bags with different credits including what is the preferences of the customer/consumer, the ingredients used in small sachets, benefits of the ingredients used in a tea bag, multiple use of the tea bag, handling ease, and profit ratio to both manufacturer and the customer. The tea bags share is about 3–4% of the tea sold in the retail and is still increasing at the fastest pace with almost about annual growth of 50–60% in India [18, 19]. The raw material used for producing the tea bags is the pivotal element that offer the product and services that satisfy the needs of the market and helps in market analysis, which maybe in the form of tea, herbs alone or in combination, while other many elements can also affect the compliance of tea bags by the purchaser/ end-user are the rate of diffusion, the amount of drug extracted, the phytochemical potential of the herbs used in polyherbal, amount of drug-loaded in the tea bag, dimension of the bag and caution while choosing the material and preparation of the infusion . The study related to different criteria as the type of material used for tea bag, temperature, pore size, infusion rate, tea bag

shape, loading capacity and holding time has been considered [20].

Need for tea bags

Interestingly the use of herbal infusions has increased a lot, due to the presence of naturally derived agents and probable health benefits. Looking into the benefits, the present study was to gather evidence for five herbs that were converted into polyherbal infusions and tested for the antidiabetic potential [21, 22]. The population throughout the world preferably starts a day with a tea, and if the tea comes in the medicine form it would be easy and convenient for the patients with mild diabetes to take the medicine in an easy way to control their blood sugar level. The recent study is designed to covert the most common herbs which are having good potential to control the blood sugar level. The herbs selected are having different active ingredient which does not show the side effects shown by synthetic medicines e.g., flatulence and GIT problems which are caused by the most common metformin [8] or α-glycosidase inhibitors such as acarbose are been resolved by the polyherbal formulation which contains a combination of *Ichnocarpus frutescens* (IC), *Ficus dalhousiae* (FD), *Creteva magna* (CM), *Alpinia galanga* (AG) *and Swertia chirata* (SC). The details of the drugs used in making the polyherbal formulation are given in **Table 2**. The polyherbal formulation contains many constituents like xanthone, catechin, and polyphenols which gives a feel of drinking tea and is not a medicine that would be greatly accepted by the patients.

Table 2: Details of five drugs used for making polyherbal formulations.

Composition of Polyherbal formulation			
Common name (Hindi name)	**Botanical name**	**Part used**	**Family**
Kalidudhi Angir Barna Galangal Chirayita	*Ichnocarpus frutescens*, *Ficus dalhousiae*, *Crateva magna* *Alpinia galanga* *Swertia chirata*	Aerial part Fruits Aerial part Rhizome Roots	Apocynaceae Moraceae Capparaceae Zingiberaceae Gentianaceae

***Ichnocarpus frutescens* L. [IC]**, is a plant belonging to the family Apocynaceae is widely cultivated in varied latitudes of the world and is the common line tree, known as a black creeper in English [13]. The literature study shows that *Ichnocarpus frutescens* L. roots have been used as diaphoretic, diuretic, demulcent, stimulant, dyspepsia, gall stones,tonic and diabetes. The axial and shoot portion is also used as antidiabetes [23] (**Figure 1**).

***Ficus dalhousiae* miq. [FD]**, family Moraceae. These are endangered species and grow at a higher altitudinal range of 605–1370 m in the Nilgiri Mountains. It grows 10 m tall; the bark is usually brownish and the leaves are simple and ovate in structure. It grows in moist deciduous forests, native of Southern Western Ghats. The rate of growth of this tree is very slow, and hence it's considered an endangered plant species list [24]. Fruit is used as a cardio tonic, for treatment of liver and skin diseases the leaves and bark are used. An extract made out of the leaf contains antidysenteric properties. Antispasmodic activity is treated by roots. The bark is used as an anti-cancer and in reduction of hyperlipidaemia [25] (**Figure 2**).

Figure 1: *Ichnocarpus frutescens* L

Figure 2: *Ficus dalhousiae*

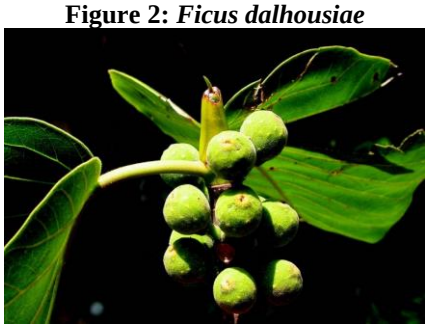


Figure 3: *Crataeva magna*

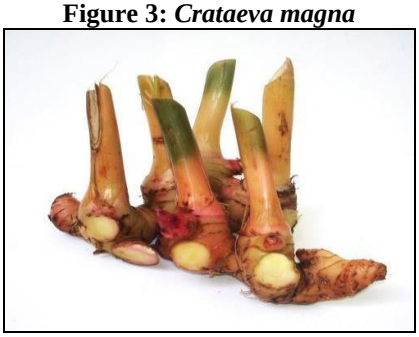


Figure 4: *Alpinia galanga*

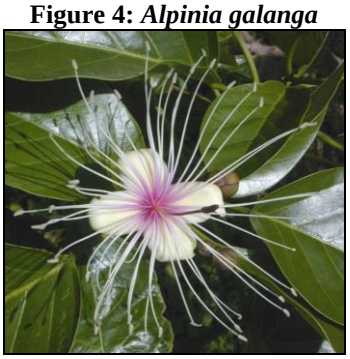
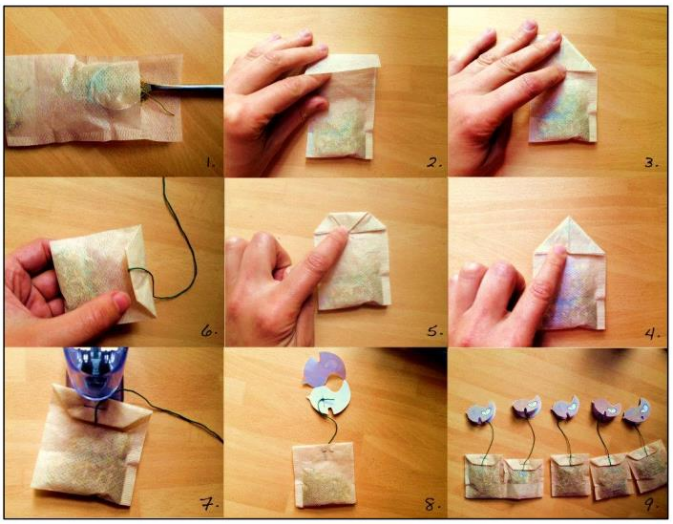


Figure 5: *Swertia chirata*

Figure 6: Method of preparation of polyherbal tea bag.



***Crateva magna* (Lour.)[CM]** family- Capparaceae, is a valuable medicinal tree, it's a medium-sized deciduous tree, which grows in a tropical climate in the region of the world and grows maximum in the semiarid regions of India. In traditional systems of medicine (Ayurveda and Unani), the plant is used in the treatment of urinary dis-functioning [26, 27]. CM has diuretic, lithotriptic, tonic properties and demulcent action [28-30]. Because of its anti-inflammatory and anti-arthritic activity CM is majorly used in many parts of India. In various regions of India, the plant parts (root, stem, flower and leaves) are used as antipyretic either in combination with other herbal drugs or used individually. The juice /solution prepared by the use of the root is used majorly as antipyretic in the whole part of India. It is proven beneficial in many different disorders related to kidney, pain, urinary tract infections, intermittent fever, renal stones, asthma, and bronchitis. Chemical constituents majorly present in the bark are flavonoids (rutin, quercetin, catechin,) triterpenoids (α and β-amyrin, friedelin, ceryl alcohol, lupeol, lupenone, betulinic acid, 4-taraxasterol,), and alkaloids like cadabicine [31-33] (**Figure 3**).

***Alpinia galanga* [AG]**, is a native, local medicinal plant found in Southeast Asian countries like China, India. This plant is broadly used as a flavoring agent and also used as traditional medicine for various disorders [34]. The phytochemical constituents which are actively found are glycosides, essential oils, diterpenes, tannins and phenolic compounds. It is suggested to possess varied uses as stomachic, antiflatulent, carminative, anti-itching antifungal, and antidiabetic activity [35, 36] (**Figure 4**).

***Swertia chirata* [SC]**, is a local of the temperate Himalayas, which grows at an altitude of 1200-3000m, in a region from Kashmir to Bhutan as well as in the Khasi hills at 1200-1500 m altitude. The active phytochemical constituents are known are Xanthone, Seco-iridoid glycoside, Hopane triterpenoid, Aromatic carboxylic acid, Dimeric xanthone, triterpenoid alkaloid, Triterpene alcohol, Hexane extract, and Sterol. Actively used for the treatment of antimalarial, hepatoprotective, anticonvulsant, CNS depressant, anti-inflammatory, anthelmintic, and antidiabetic activity [37, 38] (**Figure 5**).

According to the above information, there is no scientific evidence available regarding the anti-diabetic potential of the above-mentioned drugs in a polyherbal formulation form. List of scientifically proven and reported antidiabetic activity of the individual herbs used in the polyherbal formulation is given in **Table 3**. The present research aims to assess the Antidiabetic potential of the polyherbal formulation by the use of a novel drug delivery system i.e. in the form of a tea bag.

Table 3: List of scientifically reported antidiabetic activity of the individual herbs used in the polyherbal formulation.

Plant name	Part used	Antidiabetic Activity method
Ichnocarpus frutescence [6,39,40]	Flower	Alloxan and Streptozotocin induced
Ficus dalhousiae [41,42]	Whole plant	Alloxan and Streptozotocin induced
Creteva magna [43,44]	Arial parts	Alloxan and Streptozotocin induced
Alpinia galangal [45,46]	Roots and rhizomes	Alloxan and Streptozotocin induced
Swertia chirata [47,48]	Roots and rhizomes	Alloxan and Streptozotocin induced

MATERIALS AND METHODS

Preparation of Formulation: The ingredients as shown in **Fig.2-5** were procured from Tamil Nadu and were properly authenticated by botanist Mr. Madhav Chetty.

All the ingredients were properly dried, powdered and combined thoroughly in different compositions as Formulation-1 (F1) and Formulation-2 (F_2) Formulation-3 (F_3) Formulation- 4 (F_4) of IC, FD, CM, AG and SC.

- Formulation-1 (F1) = 0.5gm IC + 0.5gm FD + 0.5gm CM + 0.5gm AG + 0.5gm SC
- Formulation-2 (F_2) = 0.7gm IC + 0.7gm FD + 0.7gm CM + 0.5gm AG + 0.5gm SC

- Formulation-3 (F_3) = 0.7gm IC + 0.5gm FD + 0.7gm CM + 0.5gm AG + 0.7gm SC
- Formulation- 4 (F_4) = 0.7gm IC + 0.7gm FD +0.7gm CM + 0.7gm AG + 0.7gm SC

The extracts (F1, F2, F3 and F4) were prepared in the tea bag form and tested for their antidiabetic activity.

Selection of tea bag paper: Papers of synthetic fiber which are heat sealable are used in a tea bag [49]. Tea bag filter paper was made up of cellulose material having tensile strength very high and porosity is also high which provides good durability and protection layer for the content inside the bag [50]. Furthermore, cellulosic material tea bag filter paper is cheaply available and nontoxic [51].

Tea-bag paper shape: Tea-bags of diameter 8.5 × 6.1 cm were made in rectangular shape and 7.8 cm round-shaped tea bags were used to study the rate of active constituent release as shown in **Figure 6**. The tea bag with a surface area of 49 cm^2 produced very minor consequences on the rate constants, which was carried out at a temperature of 80°C [52]. Four different dimensions of square tea bags were used i.e., 16, 36, 49, and 64cm^2, and for round and rectangular tea-bags the dimension was kept 49 cm^2. These were dipped in 400 mL distilled water which was kept at the constant temperature of 80°C in a thermostat bath were proper care should be taken to avoid the air bubble and it should remain flat on the surface of the wire mesh submerged in water [53]. It is been remarkably observed that there is a rise in the rate of extraction as the size of tea-bag increases from 16 to 36 cm^2 which was approximately 25% - 30% compared to the tea-bags of larger dimension i.e. more than 36–64 cm^2. Studies were carried out to check the extraction efficiency of tea-bag of the polyherbal drug, measurement was carried by full factorial experimental design and the parallel study was done between loose herb and tea bag. The particle size of the herbs used in the Tea was large (1.80–1.20 cm) with 51 by 50mm bag size in which continuous shaking was carried out whereas in the other set small particles of (250–500 mm) with (40mm) bag size and no change (static) were observed. The extraction rate was profound in the tea-bag which are continuously sunk and dipped inside compared to the floating tea-bags [54].

Infusion time: 40 specimens of loose herbs and polyherbal tea-bags were selected which contain an equal number of loose herbs and tea-bags from different formulations F1, F2, F3 and F4. All samples were submerged in 250 mL distilled water and dipped at for 5 min at 80°C.with constant slow agitation whereas the loose herb (1.5-2 g) was sunk in 250 mL at different times intervals like 5, 10, 15, 20, and 30 min at 80°C and was analyzed. The interpretation of results reveals that ≤ 45% of phenols and flavonoids i.e., the water-soluble components were extracted by the first-order kinetic. The time for an infusion of 12 min for loose herbs and 3 min for tea bags were sufficient for extraction of active ingredients like antioxidants and phenols [55]. Comparison between formulations F1, F2, F3 and F4, was carried out to see the difference in their sheer times, the capacity of tea-bags and effect on total drug content in the polyherbal formulation. Large size tea-bag (1.80–1.20 mm) were enclosed in 51 × 50mm tea-bags with constant slow shaking were compared to the small particle size tea-bag of 250-500 μm and bag dimensions of 40 × 45 mm were kept at constant steady shaking. The rate of release of herb solutes from the tea bag is directly proportional to the smaller pore size of the tea-bag [56].

Tea-bag loading: Bicameral tea bags having 1–3 g and 0.25–3 g of tea particles was kept at a temperature of 60°C for 15 min at 5 dips per minute to check the loading effect of tea-bag [55]. Particle sizes of 850, 710, 500, 212 mm were used for the formulation of F1, F2, F3, F4 and the extraction efficiency was calculated [57].

Phytochemical Screening: The formulations F1, F2, F3 and F4 were subjected to the determination of preliminary phytochemical analysis (**Table 4**) to identify different groups. Two different constituents' i.e., active constituents and inactive ones are found [58]. The preliminary phytochemical screening helps in the identification of the presence of chemical entities present in plants (**Table 5**).

Table 4: Preliminary Screening of secondary metabolites.

Phytochemical Test	Reagents used (test performed)	Inference
Alkaloid	Mayor's reagent	The appearance of yellow cream ppt
	Wagner's reagent	Reddish-brown ppt
	Dragendorffs reagent	Brick red/ reddish brown ppt
	Hager's reagent	Formation of yellowish-white ppt
Carbohydrates	Molish's reagent	Formation of violet ring
	Benedict's reagent	Formation of orange-red ppt
	Fehling's reagent	Formation of red ppt
Saponins	Foam test	Produces form that lasts for 10 minute
Glycoside	Reducing sugar test (Test I and test II)	Formation of brick red ppt.
Phytosterol	Salkowski test	Formation of golden-brown color
Fats and fixed oils	Filter paper press test	oily stains obtained
Resins	Acetone water test	Appearance of turbidity
Phenol	Ferric chloride test	The appearance of bluish-

		black ppt
Tannins	Gelatine test	Formation of white ppt
Diterpenes	Copper acetate test	Formation of bright green color
Flavonoids	Alkaline reagent test	Intense yellow color is obtained
	Lead acetate test	Yellow ppt is obtained
Proteins	Xanthoprotein test	Formation of yellow color

Physicochemical parameters like the ethanol extractable matter (both hot and cold), water-extractable matter (both hot and cold), total ash, acid insoluble ash, water-soluble ash, and moisture content, of polyherbal were evaluated by the set of guidelines given by World Health Organization (WHO) for assessing the quality control of herbal products. (**Table 6**).

In vitro testing was carried out Spectrophotometrically by amylase inhibition method to identify α - amylase enzyme, which helps in digestion and metabolism of carbohydrates majorly polysaccharide. The present study is designed to elicit the effect of α-Amylase on the rate of reaction as well as the Inhibition activity of different polyherbal formulations prepared [58].

Procedure: 1 ml of α - amylase was mixed along with 1 ml of polyherbal extract in a test tube and kept at a temperature of 37°C for 10 min. After prior incubation, 1ml of 1% solution of (v/v) starch was added to all the test tube and incubated at 37°C Temperature for 15 min. The reaction was completed with 2 ml DNSA reagent, which was kept in the boiling water bath for about 5 min, then brought back to room temperature, again diluted, absorbance was checked at 546 nm. In the control group the enzyme activity was found to be 100% which was deprived of any plant extract. Maximum safety precaution was taken to avoid the errors [58].

The formula for calculating the % inhibition of α - amylase of the individual plant extract -

$$\% \text{ inhibition} = \frac{(\text{Enzyme activity of control} - \text{Enzyme activity of extract})}{\text{Enzyme activity of control}} \times 100$$

RESULTS AND DISCUSSION

Phytochemical screening: The preliminary phytochemical screening tests for formulations (**Table 5**) revealed some constituents like Alkaloids and Tannins in all listed plant samples. No presence of Anthraquinone was found. While Glycosides, Flavonoids, Reducing Sugar and Saponin were evident in the plant's samples. The preliminary phytochemical parameters like Total Ash, water-soluble ash, moisture content, acid-soluble ash etc. are reported in **Table 6**.

Table 5: Phytochemical analysis of different Aqueous extracts:

Test	***Ichnocarpus frutescens,***	***Ficus dalhousiae,***	***Crateva magna***	***Alpinia galanga***	***Swertia chirata***
Alkaloid	+++	+++	+++	+++	+++
Carbohydrates	+++	+++	+++	+++	+++
Saponins	--	-	-	+	-
Glycoside	+++	+++	+++	+++	+++
Phytosterol	+	+	+	+	-
Fats and fixed oils	--	+++	+	-	-
Resins	--	+	+	-	-
Phenol	--	-	--	+	--
Tannins	+++	++	--	+	--
Diterpenes	--	++	+	+	-
Flavonoids	+++	+++	+++	+++	+++
Proteins	--	++	--	-+	-

+ indicate the presence of constituents and - indicate the absence of constituents.

Table 6: Physicochemical parameters of Polyherbal Formulation

Physicochemical parameters Amount	**(% dry weight basis) F1**	**(% dry weight basis) F2**	**(% dry weight basis) F3**	**(% dry weight basis) F4**
Moisture content	5.6 ± 0.2	5.2 ± 0.1	5.5 ± 0.1	5.3 ± 0.2
Total ash content	6.5 ± 0.1	6 ± 0.2	6.2 ± 0.2	6.3 ± 0.2
Water soluble ash content	1.2 ± 0.1	1.2 ± 0.2	1.1 ± 0.2	1.5 ± 0.2
Acid soluble ash content	0.8 ± 0.0	1 ± 0.2	1.2 ± 0.2	0.9 ± 0.2
Hot ethanol exactable matter	10.5 ± 4.1	9.6 ± 2.2	10.6 ± 1.2	11 ± 3.2
Cold-ethanol	8.6 ±	7.8 ±	8.5 ±	9 ± 0.2

extractable matter	0.2	0.2	0.2	
Hot-water extractable matter	7.5 ± 0.2	7.6 ± 0.2	7.7 ± 0.2	6.6 ± 0.1
Cold-water extractable matter	4 ± 0.1	3.6 ± 0.2	3.9 ± 0.1	4.2 ± 0.2

Data represented as mean ± SEM (standard error mean); *n* =6.

***In vitro* Alpha-Amylase Inhibitory Activity:** The digestion of carbohydrates, proteins and fat is carried out with the help of different gut enzymes. Some specific enzyme that carries out the digestion of α - Amylase catalyzes the conversion of polysaccharide converts in to disaccharide and monosaccharide and then the monosaccharide is been absorbed in the stomach and small intestine. The breakdown of polysaccharides to monosaccharides in the alimentary canal occurs at a faster pace. An increase in hyperglycaemia takes place which further lead to hyperinsulinaemia immediately after the ingestion of food. As the concentration of α -Amylase is directly proportional to the rate of reaction with less time to carry out the reaction because of the potency of α - Amylase will help in the breakdown and digest the starch rapidly [59, 60].

Different infusions of the formulation i.e. F1, F2, F3, and F4 were used. These infusions were studied for α - amylase inhibitory activity Vs. porcine pancreatic amylase [60]. In which the F3 (91.6%) and F4 (92.7%) showed higher inhibition rate against porcine pancreatic α -amylase among the 4 formulations. The % α - amylase inhibition in F2 (90.4%) was the lowest. **Table 7** shows the % inhibition of α - amylase activity of polyherbal infusion and **Figure 7** shows the Graphical representation of the same.

Figure 7: Graph representing % alpha amylase inhibition by different polyherbal infusions.

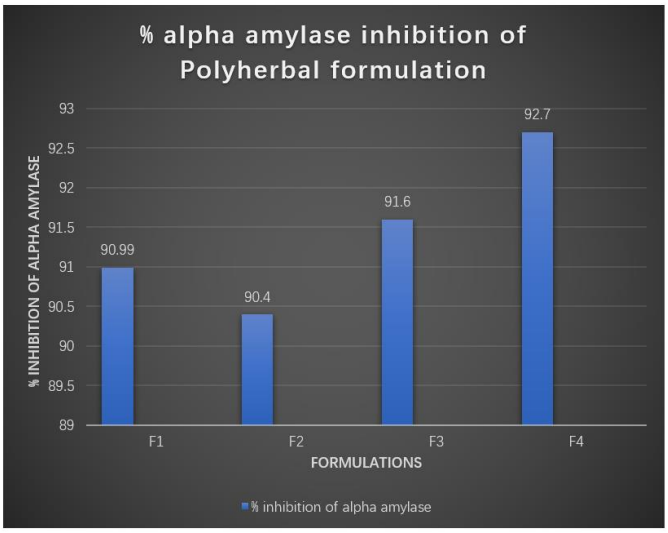


Table. 7: % alpha-amylase inhibition by different polyherbal infusions.

S no.	Formulation	Optical density	%Inhibition of alpha-amylase
1	F1	0.189	90.99%
2	F2	0.205	90.4%
3	F3	0.382	91.6%
4	F4	0.475	92.7%

Thus, data derived indicate that infusion which was formulated according to F3 and F4 formulation has a noteworthy antidiabetic potential out of all other formulation. The effects are observed due to the activity of carbohydrate-binding regions on α - amylase, endoglucanases, α - glucosidase enzyme that increases the breakdown of the α-1, 4 glycosidic linkages in the polysaccharide which also helps in the reduction of postprandial hyperglycaemia by which the plants exerted action [60]. The enzyme is responsible for converting the starch in the food into smaller monosaccharide's which helps hydrolysis to glucose before the absorption. The enzyme α- amylases play an important part in catalyzing the polysaccharide in a living organism, the presence of these type of inhibitors in diet may be responsible for improper starch digestion [61].

CONCLUSION

The polyherbal formulation is nothing but a combination of several different herbs which give harmonious and combined effects. Many herbal products now a days, including traditional medicine formulations are used for health improvement, which may even include marine, mineral and animal sources. There are many different types of formulations available in the market which are Herbal derived. The present study depicts the polyherbal formulation of *Ichnocarpus frutescens* (IC), *Ficus dalhousiae* (FD), *Creteva magna* (CM), *Alpinia galanga* (AG) *and Swertia chirata* (SC) were used in the form of tea bag are innovative for daily consumption and maintenance of the diabetic control, by inhibiting the activity of the alpha-amylase enzyme, the above-mentioned plants give the effect as anti-diabetic activity. Many drug-development schemes are been undertaken to produce a present-day formulation with the herbal twist i.e., isolation of compounds in the form of infusion from above polyherbal plants. Although crude extracts of the above herbs maybe as a whole plant or parts of these plants have dissipated and reported many medicinal uses. Novel drugs developed by the newest technique, after intense clinical trials can be evolved after proper investigation on plant-derived active compounds, and detailed information of the drug, along with its effects and its side effects. As the global drug market is now diverting for the use of safe plant

products with high potent medicinal use, the main focus is over the development of the new therapeutic class of drugs derived from herbal sources should be highlighted in treatment as well as prevention of varied class of disorders. Focusing to make good use of plant-based herbal centuries-old knowledge through the newer technique of drug design and development. A substantial development to be carried out on these polyherbal plants and its formulation in the form of tea-bag is convenient and has better economic and therapeutic value for the population globally.

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AUTHOR CONTRIBUTION

All the authors have equally contributed in conceiving this research and designing of experiments; all authors have participated in the design and interpretation of the data; experiments and analysis; writing the paper and participated in the revisions of it. All authors read and approved the final manuscript.

ETHICS STATEMENT

The authors have taken all the necessary permissions as per ethical guidelines wherever applicable. The authors will be responsible for all the technical content mentioned in the manuscript. Journal and Publisher will not be responsible for any copyright infringement and plagiarism issue.

DATA AVAILABILITY

The data used to support the research are included in the article.

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CONFLICT OF INTEREST

The authors Mohsina F.P, Dr Aamir Quazi, Faheem IP, Mohammad A Kamal Mohammad Mukim, Gulzar Ahmed Rather and Abhinandan Patil declare that there is no conflict of interest.

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