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Insights Of Herbal Tablets Derived From Terminalia Chebula Extract: Characterization Of In Vitro Activity In Male Wistar Rats

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ABSTRACT

Diabetes mellitus is a category of metabolic disorders that cause hyperglycaemia due to inadequate insulin secretion, insulin resistance, or both, and are associated with irregular metabolism of carbohydrates, fats, and proteins. The aim of present research was to evaluate anti-diabetic potential of herbal tablets derived from *Terminalia chebula* extract using carbapol and gelatin as excipient. Diabetes was induced by injecting 150 mg/kg of alloxan monohydrate diluted in saline intraperitoneally. Blood glucose levels in two animal groups were studied in response to two different herbal tablets batches that contained Terminalia chebula extract. Wistar rats were given an oral dose of 200 mg/kg of carbopol-containing Terminalia chebula tablets, which significantly decreased the biochemical parameters in alloxan-induced diabetic rats. Anti-diabetic efficiency of Terminalia chebula extract could be attributed to increase in insulin production from pancreatic beta cells, or else it could be because of insulin stimulatory effects. Treatment of Terminalia chebula in rats suffering with diabetic resulted in weight gain, indicating that Terminalia chebula extract has a positive impact.

Keywords: Alloxan Antidiabetic activity, Gelatin, Carbopol, *Terminalia chebula* Extract.

Introduction

Many traditional remedies, including some botanical preparations, have animal or mineral sources as well[1]. The fruits of the *Terminalia chebula* plant, which belongs to the Combretaceae family, were applied to examine the anti-diabetic properties. Taiwan is the major producer of *Terminalia chebula* plants, which are indigenous to Southeast Asia and

India.It is a ripe dried fruit that has been used for centuries in Asia to treat a number of diseases[2]. It has been investigated for its homeostatic laxative, purgative, and cardiac tonic properties in herbal remedies. *Terminalia chebula* has been shown to have anti-diabetic, anti-cancer, anti-mutagenic, and anti-viral properties. However, there has been no systematic research on anti-diabetic activity mentioned in the literature[3]. Although T. chebula includes a variety of phytoconstituents.It is particularly high in tannins (about 32% tannin content) fixed oils, fructose, flavonoids, amino acids, resin and sterols. In addition, *Terminalia chebula* tannin content is strongly influenced by its geographic location.

Diabetes mellitus is a category of metabolic disorders that cause hyperglycaemia due to inadequate insulin secretion, insulin resistance, or both, and are associated with irregular metabolism of carbohydrates, fats, and proteins. These clinical manifestations might include microvascular, macrovascular, and neuropathic disorders. Most diabetic patients generally fall into two categories: type 1diabetes, caused by complete resistance to insulin, or type 2 diabetes, which is characterized by insulin secretion[4]. Gestational diabetes refers to a condition when a woman develops diabetes as a result of pregnancy stress. Tablets are pharmacological solid dosage forms that are produced by compressing powders together. Phyisco- chemical parameters must be considered when evaluating the quality of the tablets in order to ensure that the medicinal product is used in conditions that ensure its quality and therapeutic efficacy throughout the duration of its shelf life[5].

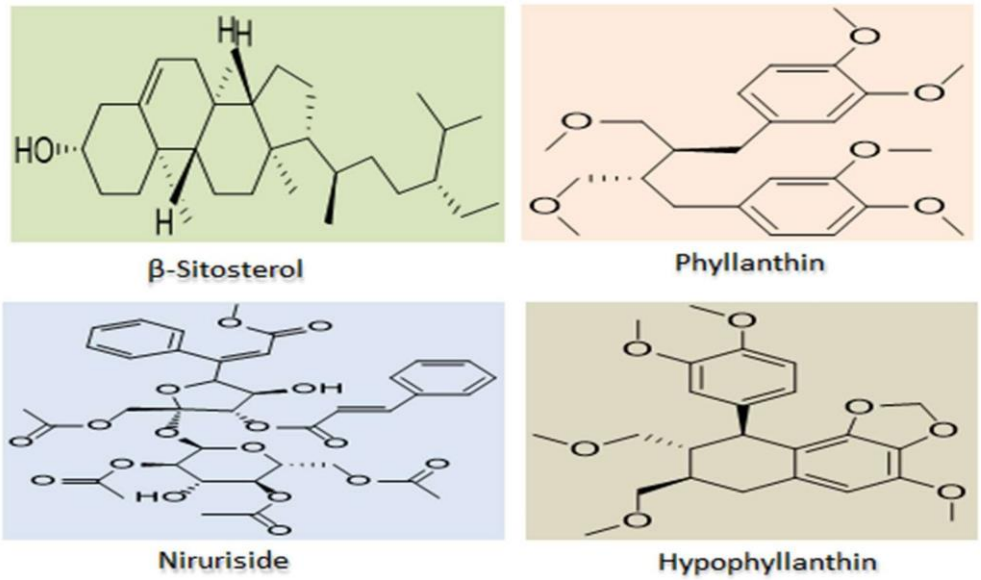


Fig.1: Chemical structure of phytoconstituents of *Terminalia chebula*

MATERIALS AND METHODS

Collection and authentication of Terminalia Chebula

Terminalia chebula fruits were obtained from a local market in Panipat, Haryana, India. The fruits were authenticated by National Institute of Science Communication and Information Resources, New Delhi.

Preparation of extract of Terminalia Chebula

In a digital grinder, dried fruits were roughly pulverised. By using soxhlet device water, petroleum ether and ethanol were used for extraction of powder. After extraction, the deposit was concerted under reduced pressure with rotary evaporator.

Formulation

Polymers from one group, anionic (carbopol), were chosen for the formulation of GRDSS. Wet granulation technique was used to make the anti-diabetic polyherbal tablets. The first step was to make a solutioncontaining specified polymer and appropriate solvent.The excipients were then combined with the active ingredients (drug) and sieved to form granules[6]. The produced granules were then sieved and dried, withthe addition of lubricants before being compressed to make the required oral tablet.

PREFORMULATION STUDIES

Solubility studies

The solubility studies were carried out by super saturation method. For this method 20ml media was placed in a conical flask and the pure drug was continuously added (300mg of drug has been dissolved) till the superstation phase was achieved[7]. Then this solution was shaken for 24hrs in a mechanical rotator shaker. The solutions were then centrifuged for undissolved drug to settle down; supernatentent solution was diluted. The absorbance was measured at 252.2nm.

FTIR Spectroscopy study

The drug substance under investigation FTIR (model no. FT/IR-400 type A) should be absolutely dry as water absorbs strongly at about 3528 cm^{-1}. The drug was grounded and pressing elevated temperature at high pressure. The IR spectrum was obtained by scanning it in the range 4000 – 500 nm and compared with the reference.

GRANULES PREPARATION

The solution is prepared in distilled water by dissolving the desired quantity of dicalcium phosphate and starch into distilled water. On a water bath, the starch emulsion and preservative were thoroughly mixed till a semisolid translucent mass was formed. Simultaneously, carbopol and gelatin was made with desired amount of water[8-9]. The drug was kept in the motor and appropriate quantity of magnesium stearate and lactose was mixed into it. To form dough, the solution was gently combined into the mixture .The granules were then dry at a temperature of 400°C for maximum 1 hour. The granules were sized after drying and evaluated after being passed through sieve # 20.

STANDARD PLOT OF DRUG IN DIFFERENT MEDIA

In 0.1 N HCL: 25 mg drug was accurately weighed by electronic balance and then this drug was dissolved in 25 ml 0.1 N HCL to produce a stock of 1000 mcg/ml, then dilution were made to produce solution of different concentration[10]. By using double beam ultra-violet spectrophotometer, the absorbance was measured at 252.2 nm.

In 6.8 pH Phosphate buffer: 25mg drug was accurately weighed by electronic balance and subsequently mixed with 25ml of buffer solution to produce a stock of 1000 mcg/ml, then dilution were made to produce solutions of different concentrations[11]. By using double beam ultra-violet spectrophotometer, the absorbance was measured at 252.2 nm.

In pH 7.4 phosphate buffer: 25mg drug was accurately weighed by electronic balance and subsequently mixed with 25ml of buffer solution to produce a stock of 1000 mcg/ml, then dilution were made to produce solutions of different concentrations . By using double beam ultra-violet spectrophotometer, the absorbance was measured at 252.2 nm.

FORMULATION

Each 250 mg of tablet included 150mg API anddesiredexcipients. The prepared granules were mixed with the desired quantity of magnesium stearate. The mixture was then compressed into tablets using a tablet compression machine. Subsequently, random tablets were selected from five different batches and evaluated[12].

S.No	Ingredients	Batch No.				
		Quantity (mg)				
		F1	F2	F3	F4	F5

1	Plant extract	150	150	150	150	150
2	Carbopol	_	6%	_	6%	_
3.	Gelatin	6%	_	6%	_	6%
4.	Lactose	15	15	15	15	15
5.	Starch	10	10	20	20	30
6.	Di-calcium phosphate	60	60	50	50	40
7.	Magnesium stearate	15	15	15	15	15
	Total weight	250	250	250	250	250

Table 1: Composition of *Terminalia chebula* oral tablets

EVALUATION PARAMETERS

For the purpose of evaluating tablets, the following parameters were studied.

General appearance

The tablets were determined for their general appearance characteristics.

Thickness

Randomly, ten tablets were chosen per batch and thickness was measured with Vernier callipers. All of the readings were taken three times.

Hardness

Using a Monsanto Hardness Tester, hardness was measured by taking ten tablets from each formulation. The strength of a tablet is determined by its hardness. The force is measured in kilogrammes, and uncoated tablets with a hardness of 3-5 kg/cm^2 are considered suitable.

Friability

Using a Roche Friabilator, the friability was determined. Ten weighted tablets were rotated for four minutes at 25rpm.After removing fines with a muslin cloth, the tablets were reweighed.

Weight variation

The average weight was determined after ten tablets were randomly chosen from each batch and weighted individually. It's done to ensure that a batch's tablet weight is equal.

Drug content Uniformity

Using a pestle and mortar, five randomly chosen tablets were ground into powder. An exact weight of powdered tablet containing 20 mg of medicament, 100 mg was extracted with 0.1N HCL (100ml), thereafter resultant solution was filtered through membranes having pore size of 0.45µ Filtrate (1ml) was diluted appropriately to 100 ml with the 0.1N HCL, and then it was measured spectrophotometrically at 252.2 nm. The drug content of tablets was estimated from the standard plot of the drug in 0.1N HCL.

Disintegration time

The term "disintegration" refers to the process of breaking down a tablet into smaller pieces after it has been

swallowed. The "Disintegration Time" is the amount of time it takes for the tablet to disintegrate.

Place one tablet in each of the basket's six tubes [13].Place a disc in each tube and turn on the machine, keeping the immersion liquid at 37±20^{0}C.At the end, examine the tablets after lifting the basket.If all of the tested tablets have dissolved, signifies that test is done. In case, if one or two tablets do not dissolve, then conduct the test once more using an additional 12 tablets. If 16 out of the 18 tablets undergo disintegration, then all of the tablets have passed the test[14].

IN VITRO DISSOLUTION STUDIES

The test was performed for 8 hours duration at 37± 0.5°C using 0.1N HCl (pH 1.2) solution as the dissolution medium[15]. An aliquot (5 ml) was taken out at regular intervals, and the absorbance was measured by UV spectrophotometer. The release studies were carried out in triplicate.

IN VIVO ANTI DIABETIC ACTIVITY

Experimental animals

In the experiment, Wistar rats of weight (170-200gm) are used. The rats are kept in plastic rat cages with stainless steel coverlids. The animals' habitats' photoperiod is 12:12 h dark: light cycle and the temperature is 25–20°C.The animals were nurturedwith a commercial meal. The Institutional Animal Ethics Committee accepted the study protocol[16].

Research protocol approval from IAEC

The Institutional Animal Ethics Committee (IAEC) endorsed the experimental protocol, which fulfilled the requirements of the committee for the objectives of supervision and control on Experimental Animals.

Alloxan induced anti-diabetic activity

The alloxan monohydrate in a dose of 150 mg/kg intraperitoneally injection is diluted in normal saline solution to prompt diabetes in Wistar albino rats (170-200 gm) [17-18]. One hour after the Alloxan was given; the animals were given a standard laboratory food and provided drinkablewater. Capillary tubes were used to take samples of blood from retro-orbital puncture. Blood glucose levels were tested after three days of alloxan administration. Rats having blood glucose levels more than 200 mg/dl were selected for study[19].

The diabetic rats were separated randomly into five groups, each including six.

Group I is a standard control group, Group II: This group was used to manage diabetes (control).

Group III: Diabetic rats were given the conventional medication glibenclamide (10 mg/kgbody weight) for 21 days regularly, Group IV: T.C. 150 mg/kg p.o. herbal tablet (Carbopol) was regularly given to diabetic rats constantly for 21 days, Group V: For 21 days, 150 mg of TC herbal tablets per kilogramme of body weight were constantly given to diabetic rats.

Blood samples were collected prior to the medication's administration as well as on days 1, 7, 14, and 21 after it had been taken. The percentage of blood glucose reduction and changes in body weight were then determined and compared.

RESULTS AND DISCUSSION

Drug extraction yield: The yield of methanol-water extract (50:50) was 8.5 g.

Analytical Method Selection

The following is a standard plot in various media*:* In different Medias, standard plots for *Terminalia chebula* were prepared at λmax 252.2nm, 252.2nm, and 250.2nm respectively.

***Terminalia chebula* standard plot in 0.1 N HCL:** A standard curve for *Terminalia chebula* was constructed having a slope 0.5153xand coefficient of correlation is 0.996. It was found that the graph of TC's absorbance against

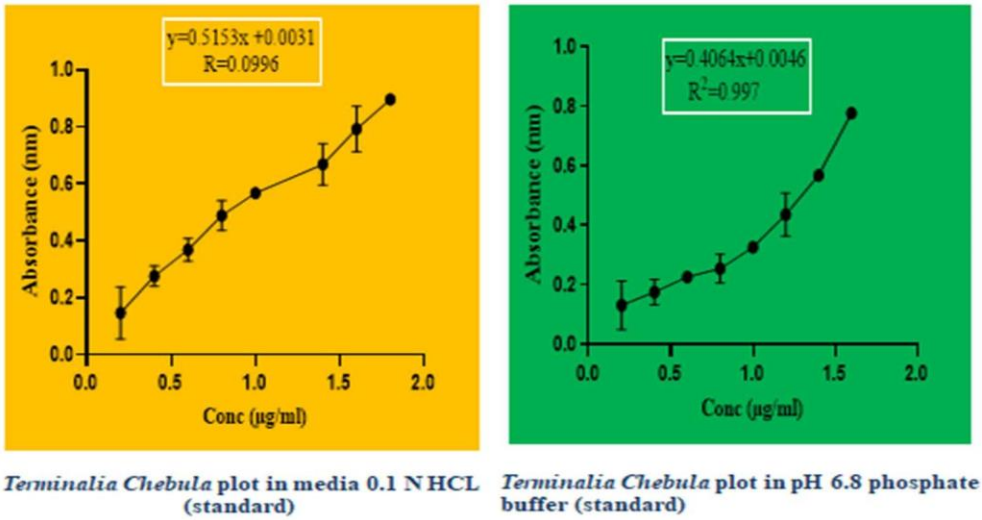
concentration was linear; following Beer's law, in a range of concentrations at 252.2 nm.Duringdrug content uniformity, solubility as well as in-vitro dissolution studies, the graph was used to determine the concentration of the medication.

Standard plot of *Terminalia Chebula* (Phosphate buffer pH 6.8): The slope of the TC standard curve is 0.4064x, and the coefficient of correlation is 0.997. It was found that the graph of TC's absorbance against concentration was linear, following Beer's law, in a range of concentrations at 252.2 nm.

S.No.	Conc.	HCL (0.1 N)		Phosphate buffer(pH 6.8)	
-		Average Abs.	S.D.	Average Abs.	S.D.
1	0.2	0.146	0.09165	0.13	0.0823
2	0.4	0.275	0.03606	0.175	0.0425
3	0.6	0.368	0.04	0.225	0.006
4	0.8	0.488	0.05229	0.254	0.0487
5	1	0.567	0.00608	0.325	0.00786
6	1.2	0.668	0.07254	0.435	0.0727
7	1.4	0.792	0.08	0.567	0.0089
8	1.6	0.896	0.0092	0.776	0.009

(All data are reported as mean ± SD, n=3)

Table 2: *Terminalia Chebula* calibration curve data



Terminalia Chebula plot in media 0.1 N HCL (standard)

Terminalia Chebula plot in pH 6.8 phosphate buffer (standard)

Fig. 2: *Terminalia Chebula* plot in different solvents 0.1N HCL and pH 6.8 Phosphate buffer (standard)

DRUG IR SPECTRA

The pure drug's IR spectrum was identified. All the major peaks were found to present .The medication was confirmed to be 100% *Terminalia chebula*.

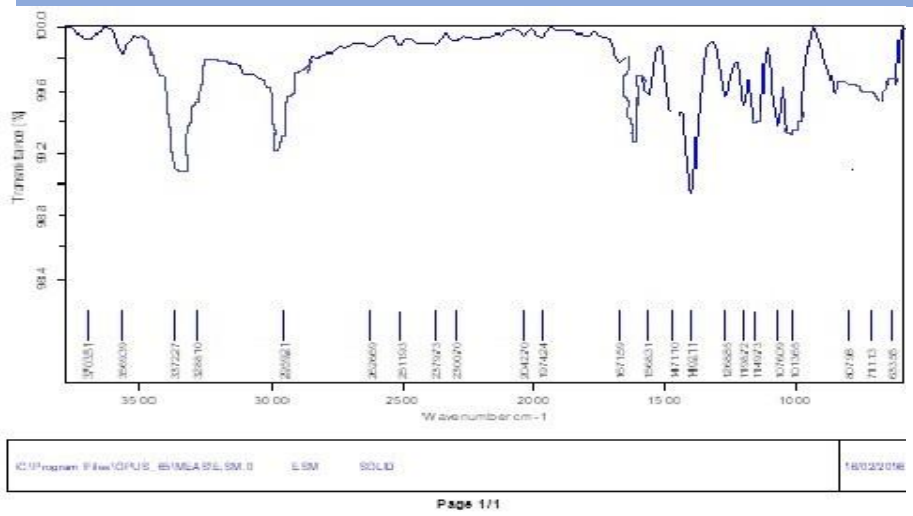


Fig. 3: IR spectra of Terminalia chebula extract

S.No.	Functional Group	Vibrations type	Peak Observed
1	C-X	Stretch	1399.1
2	C=O	Stretch	1702
3	O-H	Stretch	3528.13
4	C=O	Stretch	2917.77

Table 3: Major Infra-red band assignments for *Terminalia chebula* Extract

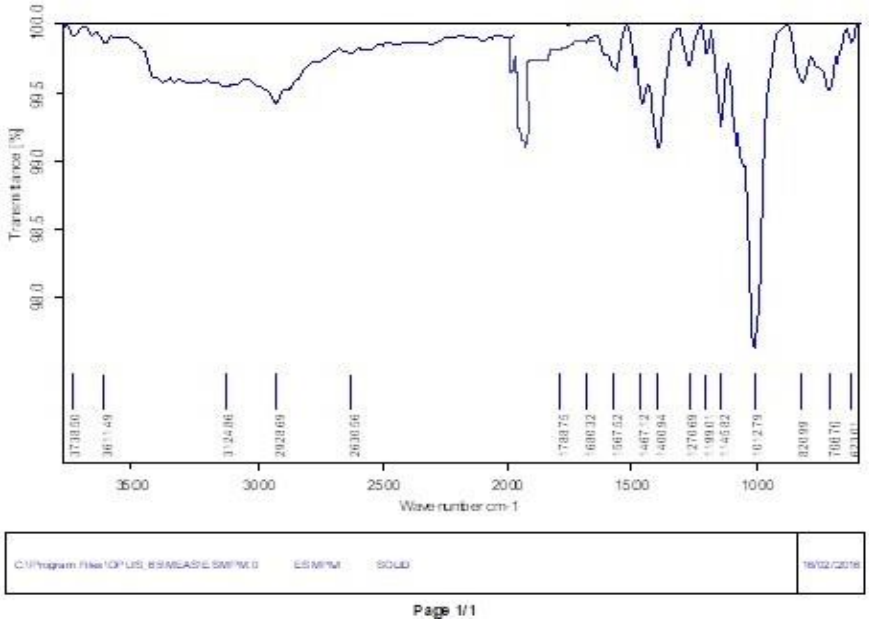


Fig. 4: IR spectra of *Terminalia chebula* tablet

S.No.	Functional Group	Type of vibrations	Observed Peak
1	C-F	Stretch	1210
2	N-H	Stretch	1615.1
3	N=O	Asymmetric Stretch	1534.1
4	C=O	Stretch	1709.59

Table 4: Major infra-red band assignments for *Terminalia chebula* tablets

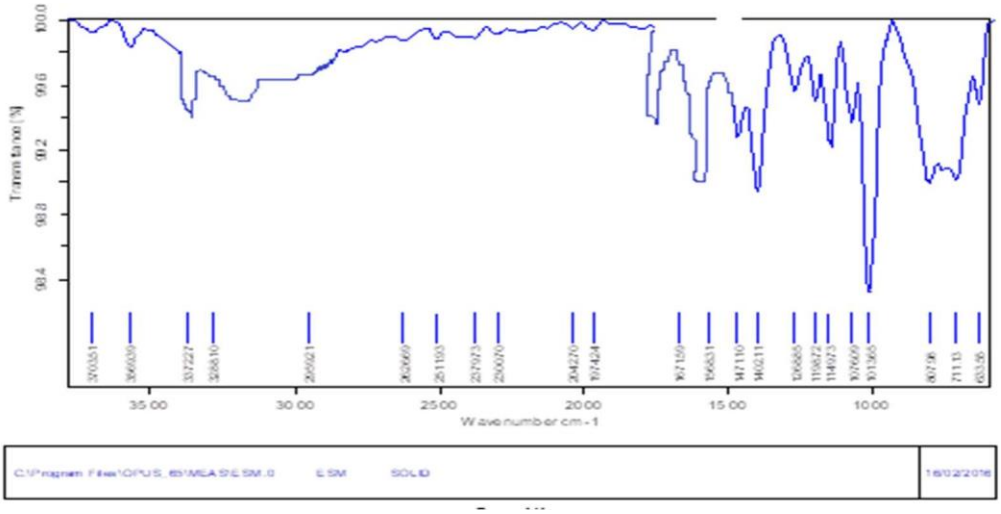


Fig.5: IR spectra of carbopol

Wavelength cm^{-1}	Assignment
3387.48	O-H stretching
1660.60	C=C stretching
1734.93	C=O stretching
1387.33	C-H deformation/ N=O stretching
1012.56	C=O stretching

Table 5: Assignment of Infrared band of carbapol

SOLUBILITY STUDIES

The drug is soluble in both 0.1 N HCL and distilled water with the use of cosolvents, indicating that solubility studies in acidic media are required. Because it did not dissolve well in acetate buffer, hence solubility tests were done in 0.1 N HCL (pH 1.2).

Solubility of the drug was found to be 0.65745 mg/ml, and was closed to the reported solubility of TC (0.63 mg/ml)

S.No.	Conc.	Absorbance	Solubility	
			0.1 N HCl	Phosphate Buffer pH 6.8
1	0.1	0.060	0.2671	0.126
2	0.2	0.062	0.335	0.137
3	0.3	0.066	0.5518	0.149
4	0.4	0.070	0.7315	0.190
5	0.5	0.074	0.9313	0.215
6	0.6	0.079	1.128	0.245

Table 6: Solubility data of drug in different solvents

GRANULAR MICROMETRIC CHARACTERISTICS

Granules were prepared using the wet granulation process. The polymer solutions were used to their respective batches to form dough which was then passed from suitable sieves, dried and granules prepared. The bulk density was estimated to be between 0.36-0.42g/cm^3. F2 has highest bulk density, followed by F4 and F5, while F1 would have the lowest.

Tapped density was found to be in the range of 0.32 and 0.38 g/cm^3. Not so much variation was found among them.The angle of repose was reported to be between 26.8° and 30.9.The percent compressibility of the granule was calculated and found to be in the range 3.0-11.62%. All the formulations exhibit excellent flow characteristics. Readings above 25% signify poor flow capabilities, while values below 15% often indicate excellent flow characteristics. The Hausner ratio is used to determine powder flow parameters. Hausner ratio of less than 1.25 implies a free-flowing powder, whereas a ratio greater than 1.25 indicates a powder with limited flow capacity. As a result, the obtained result is within accepted limits, and the granules will not cause any problems during tableting.

Granular Micrometric characteristics

Codes	Angle of repose (°)	Bulk density in (gm/cm^3)	Tapped density in (gm/cm^3)	Compressibility Index (%)	Hausner's ratio
F1	28.9±1.66	.39 ±.06	.32±.05	5±1.04	1.05±.06
F2	25.0 ±1.45	.42 ±.02	.38 ±.08	3±1.09	1.1±.04
F3	30.9 ±1.05	.36 ±.03	.34 ±.06	9±1.05	1.25±.07
F4	26.8±1.11	.40 ±.05	.37 ±.03	7.69±1.03	1.08±.01
F5	29.1 ±1.79	.38 ±.02	.34 ±.04	11.62±1.01	1.13±.03

Table 7: Data of Granules Micrometric characteristics

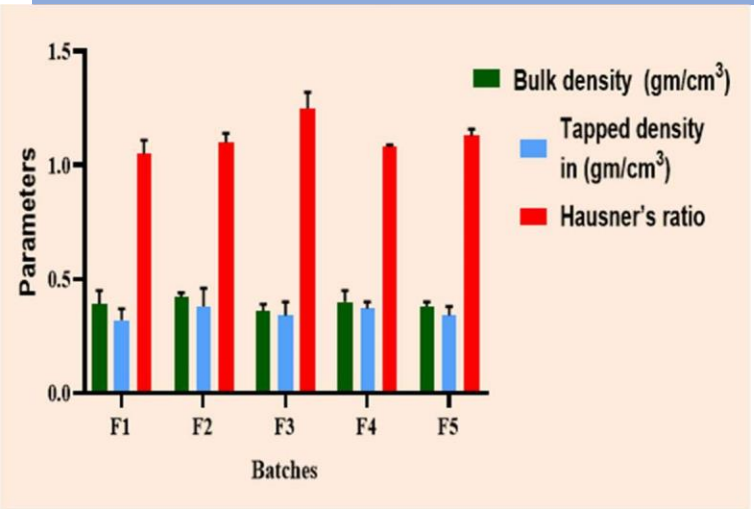


Fig. 6: Granules Bar graph showing Hausner's ratio, Bulk density and tapped density containing *Terminalia chebula* extract

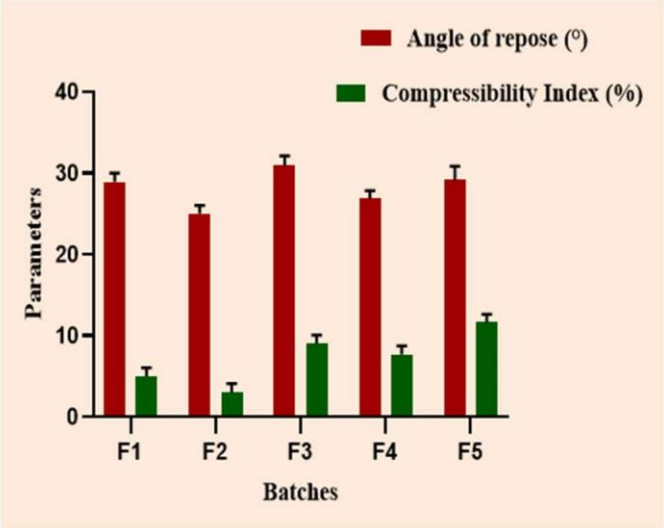


Fig. 7: Bar Graph showing Angle of repose and % Compressibility index of granules containing *Terminalia chebula* extract

IMAGES OF DIFFERENT BATCHES OF TABLETS

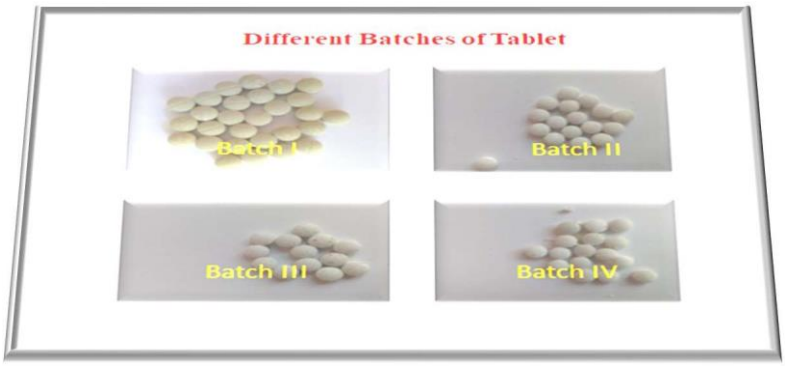


Fig. 8: Images of various oral herbal tablets containing *Terminalia chebula* extract by using different

polymer in different ratio

EVALUATION PARAMETERS

All tablets were smooth and concave in shape, without any physical flaws and off-putting odour. The carbopol and magnesium stearate tablets were greenish in colour, as was the pure form of TC.

For several formulations, the thickness ranged from 3.3±0.15 to 3.6±0.15 mm, with little fluctuation within the same formulation. The hardness ranged between 4.1±.30 and 4.6±.17 kg/cm^2. The standard deviation data illustrate that all of the formulations hardness is nearly constant, having high mechanical strength to resist handling, packaging, and shipping shocks without disintegrating. Friability was determined to be in the range of 0.58-0.66 % .All of the results were less than 1%, demonstrating that the tablets have good formulation and were resistant to mechanical, stress, and abrasion. Low standard deviation showed that the drug was homogeneously dispersed in all the formulations to meets the pharmacopoeia specification. The disintegration rate of Terminalia chebula F1, F2, F3, F4, and F5 tablets was acceptable, especially since uncoated USP medications have disintegration times as low as 15 minutes. The time taken for *Terminalia chebula* tablets to disintegrate ranged from 9:45±0.10 to 13:33±0.20 (min: sec).

Batch code	**Weight variation (mg)**	**Thickness (mm ± SD)**	**Hardness (kg/cm^2)**	**Friability (%)**	**Disintegration time(min:sec)**
F1	250.1±1.57	3.6±0.15	4.1±0.5	0.61±0.03	9:45±0.10
F2	246.5±2.13	3.4±0.19	4.6±0.17	0.58±0.02	10:34±0.40
F3	256.4±1.15	3.3±0.15	4.1±0.30	0.63±0.02	11:29±0.30
F4	247.6±1.55	3.3±0.18	4.2±0.25	0.66±0.03	13:33±0.20
F5	252.4±2.31	3.5±0.20	4.2±0.21	0.62±0.01	11:35±0.10

Table 8: Data from various evaluation parameters of *Terminalia Chebula* oral tablets

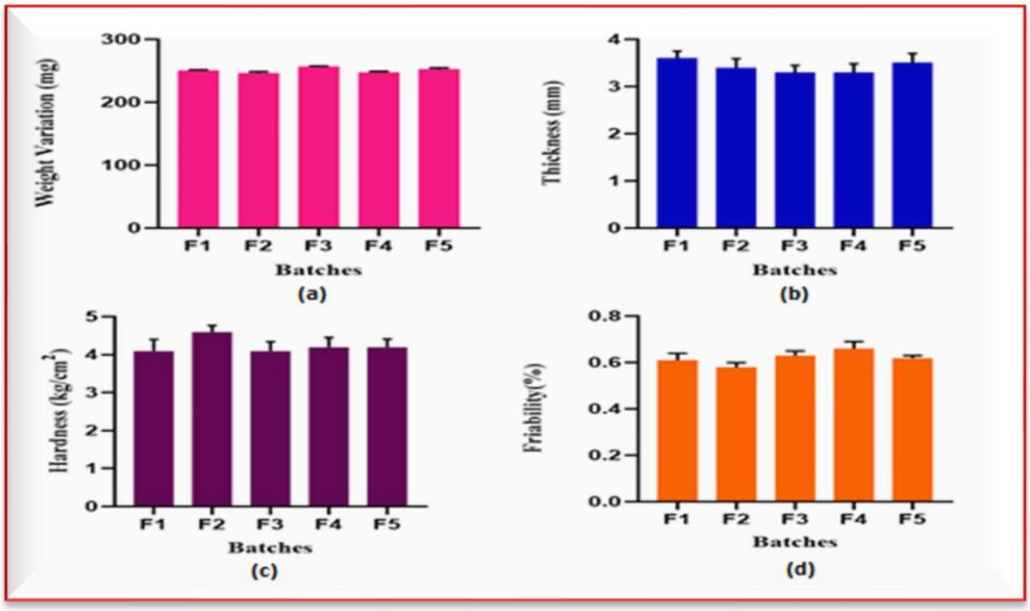


Fig.9: Bar Graph representing (a) Weight variation (b) Thickness (c) Hardness and (d) Friability of *Terminalia chebula* extract herbal tablets

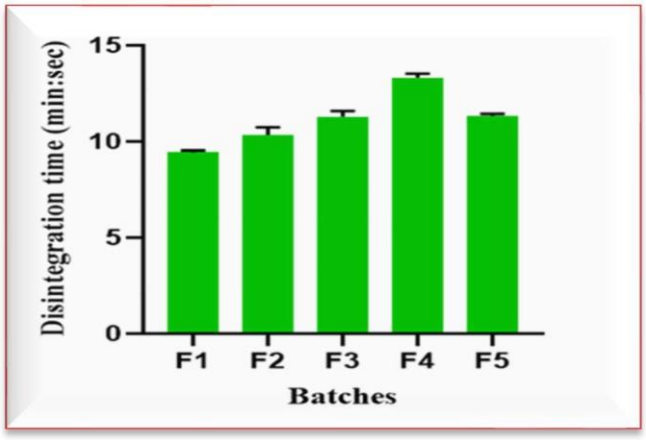


Fig. 10: Bar Graph of Disintegration time of herbal tablets containing *Terminalia chebula* extract

IN VITRO DISSOLUTION STUDIES

S.No.	Batches	Cumulative % Drug Release (Hrs)					
		1	2	4	6	12	18
1.	F1	44.60±4.12	52.67±3.14	59.56±4.16	66.87±3.16	77.90±5.17	79.90±6.17
2.	F2	40.02±3.16	49.78±5.17	54.45±6.13	60.76±4.15	67.48±5.14	71.48±4.14
3.	F3	25.98±4.19	35.76±3.15	41.23±6.17	45.56±4.17	55.45±5.16	59.45±3.16
4.	F4	43.60±3.11	55.67±5.18	59.78±4.15	63.65±.414	73.78±3.18	78.78±4.18

5.	F5	34.65±3.13	43.54±5.12	49.12±3.18	54.12±3.18	63.12±5.15	67.12±4.15

Table 9: *In vitro* drug release profile of different formulations

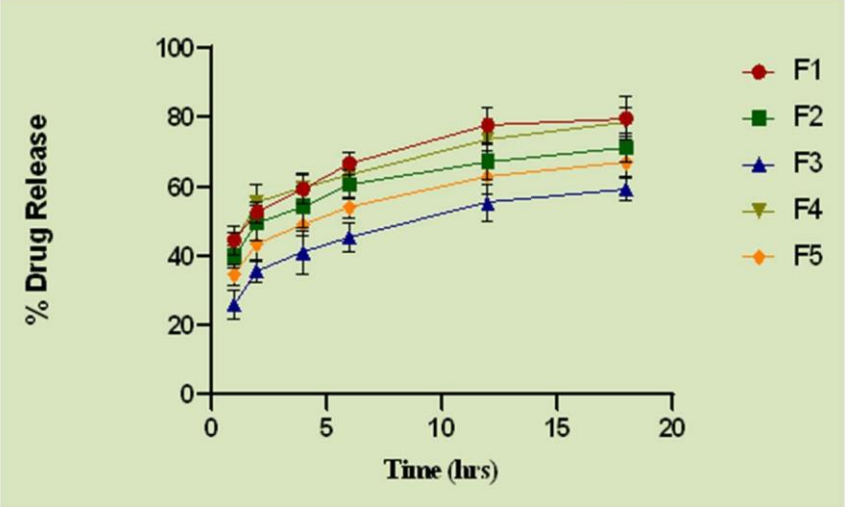


Fig. 11: % Drug release of different formulations of herbal tablets containing *Terminalia chebula* extract

ANTI-DIABETIC ACTIVITY

The blood glucose levels of two different groups of animals were studied with two different batches of Terminalia Chebula extract herbal tablets (Carbopol & Gelatin). Once compared with the diabetic control group, the level of blood glucose in both groups of alloxan-induced diabetic rats is significantly decreased. Carbopol as well as Gelatin reported 262.66±8.26 and 270.16±8.20 basal blood glucose levels. After 7 days, both doses resulted in a constant decrease in blood glucose level (144.50±5.92, 156.66±2.45) and a significant reduction in blood glucose levels subsequently 21 days (108.33±5.58 and 117.33±4.86). Carbopol, on the other hand, has a greater influence than Gelatin. The initial blood glucose level was found to be 263.66±12.49 in standard group, the blood glucose level after 21 days was 93.00±5.47, indicating that the standard drug seemed to have the greatest hypoglycaemic effects, and the statistical data was considerably vital and somewhatgreater than the test groups[20]. Throughout the study, the untreated diabetic rat group demonstrated rise inblood sugar level. In the untreated diabetic control group the blood sugar level was primarily 258.50±8.06, but it had increased to 297.66±4.13 after 21 days.

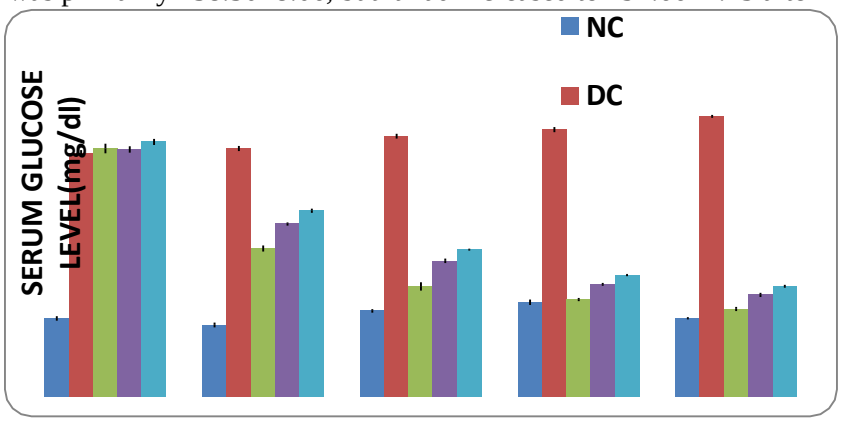


Fig. 12. Effect of *Terminalia Chebula* herbal pills on blood glucose levels

Glibenclamide (10 mg/kg), NC- Normal control, STD- Carbopol-Extract of *Terminalia chebula* (150 mg per kg of body weight) alongwith binder carbopol, DC- Diabetic control.

Gelatin- Extract of *Terminalia chebula* in strength of (150 mg per kg of body weight) along with binder gelatin.

One-way ANOVA as well as Tukey's Multiple Range Test were used to statistically assess the data collected from various groups. Statistical significance is defined as a value of less than 0.05.

EVALUATION OF ANTI-DIABETIC ACTIVITY

In alloxan-induced diabetic rats, *Terminalia chebula* extracts herbal tablets caused considerable decrease in blood glucose. In comparison to herbal tablets containing gelatin, the all-out result achieved by the *Terminalia chebula* herbal tablet comprising carbopol shows maximum result. The sharp decline was sustained at the constant level. *Terminalia chebula* anti-diabetic efficiencycould be due to high insulin secretion from the pancreatic- beta cells, or else it might be due to insulin stimulatory effects.In diabetic rats, treatment with *Terminalia chebula* resulted in a considerable weight gain, indicating that *Terminalia chebula* extract has a beneficial effect. Furthermore, the maximal efficacy shown by carbopol-containing tablets is due to carbopol's minimal binding feature, permits the tablet to break down easily in the stomach and provides more availability as compared to gelatin-based tablets.

DISCUSSION

Herbal constituents may comprise a single herb or a mixture of multiple herbs with the goal of creating a synergistic effect. Animal products and minerals are used in certain botanical preparations, including many traditional medicine formulations. For the evaluation of anti-diabetic effects, fruits from the *Terminalia chebula* plant, family Combretaceae, were employed. Hence, in the current study, polymeric anionic polymers and wet granulation technique is used to formulate herbal tablets having *Terminalia chebula* extract. Five formulations of *Terminalia chebula* extractwere developed containing carbopol and gelatin. The extract was available in the strength of 150 mg within all the formulations, with lactose, di-calcium phosphate and magnesium. All of the formulations possess good flow characteristics and were compacted into 250 mg tablet. Physicochemical considerations including thickness ranges from 3.3± .15 to 3.6±.15(mm), hardness 4.1 ±0.5 to 4.6±0.17 (kg/cm^2), friability 0.58± 0.02 to 0.66 ± 0.03 (%), and disintegration time 9:45±0.10 to 13:33±0.20 (min:sec), was found within the specified limits. In alloxan-induced diabetic rats, anti-diabetic activity testing revealed that herbal tablets of *Terminalia chebula* extracts significantly reduced blood glucose levels. In comparison to herbal tablets containing gelatin, the result obtained through the herbal tablet containing carbopol exhibit enhanced effect.

CONCLUSION

Anti-diabetic efficiency of *Terminalia chebula* extract could be attributed to increase in insulin production from pancreatic beta cells, or else it could be because of insulin stimulatory effects. Treatment of *Terminalia chebula* in rats suffering with diabetic resulted in weight gain, indicating that *Terminalia chebula* extract has a positive impact.

COMPETING AUTHORITIES DECLARATION

The authors have no apparent or real potential conflicts of interest.

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