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PHYTOCHEMICAL SCREENING AND HYPOGLYCEMIC ACTIONS OF GYNANDROPSIS GYNANDRA HERB

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ABSTRACT

Keywords:

Gynandropsis gynandra,
ethanolic extract,
diabetes, hypoglycemic
action

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Aim: The work was aimed to perform phytochemical screening and to explore the hypoglycaemic actions of *Gynandropsis gynandra* herb.

Methods: The herb was characterised by its transverse section of midrib, stem and stomata. The fresh herb of *G. gynandra* was extracted with Ethanol by maceration. The reddish brown extract was concentrated to dryness by evaporation. The extract was evaluated for its specific physical and chemical characteristics in order to standardize it. The herbal extract at doses of 100, 250 and 500 mg/kg as fine aqueous suspension was tested on normal and Alloxan induced rats for hypoglycemic actions. The actions were compared with standard Tolbutamide drug at a dose of 40 mg/kg. The data obtained was analysed with the one-way analysis of variance (ANOVA), followed by a post hoc of Dunnett's T-test.

Conclusion: The study revealed that the *Gynandropsis gynandra* herb was found to have hypoglycemic actions compared with Tolbutamide.

INTRODUCTION

Diabetes mellitus is a metabolic disorder which affects carbohydrate, fat and protein metabolism. Diabetes mellitus is affecting nearly 10% of the population every year ^[1]. Treatment of diabetes mellitus with Insulin and oral hypoglycemics is associated with serious side effects ^[2]. This leads to increasing demand for herbal products with antidiabetic properties with negligible side effects ^[3].

Traditionally used natural herbs play a major role and constitute the backbone in drug therapy. In order to make sure the safe use of these medicinal plants, a necessary first step is the establishment of standards of quality, safety and efficacy. Keeping these parameters attempts have been made to establish pharmaconostical and physiochemical standards of *Gynandropsis gynandra* leaves. *G. gynandra* belong to the plant family *Capparidaceae* ^[4]. The common name is spider flower. *G. gynandra* is an annual herb, 30-60 cm tall, erect, viscidly hairy, leaves are digitately, 3-5 foliolate, leaflets elliptic – obovate, elliptic-lanceolate, sessile, Flowers are white and purplish ^[5] Capsules are 5-8 cm long, linear cylindric, minutely beaked, viscidly pubescent ^[6]. Seeds are depressed-spherical, blackish brown, 1.2 mm across. Flowering and fruiting in July – November. *G. gynandra* herb is indigenous to the tropical and pan tropical regions. The herb is edible and grows up to about 60cm high ^[7]. However, there were not enough scientific investigations on the anti-inflammatory and analgesic activities conferred to these herbs.

MATERIALS AND METHODS

Collection and Identification of herbal material

The entire herb of *Gynandropsis gynandra* Linn was collected from Anantapur, Andhra Pradesh, India. The herb was identified and authenticated by the Department of Pharmacognosy, Anantapur, India. The voucher specimen (number: BCP/Cog 072) was kept at the Herbarium of the Balaji College of Pharmacy, Anantapur, Andhra Pradesh, India.

Materials

Carrageenan, Sodium CMC and Diclofenac sodium were gift samples from Waksman and Selman Pharmaceuticals, Anantapur, India. Ethanol (95%) was procured from SD fine chemicals Mumbai, India. All the chemicals used were of AR grade and deionized water was used throughout the experiment.

Preparation and Extraction of herbal sample

The fresh herb of *G. gynandra* was chopped into pieces and dried under sun light for 15 days. The roots were powdered by using a mechanical grinder. The so collected powder was stored

in glass jars, tightly covered and kept in refrigerator (-4°C) till use. The root powder (800g) was extracted with Ethanol (3 lt) by maceration for 48 h^[8] and filtered at room temperature (25°C). The reddish brown extract was concentrated to dryness using a rotary evaporator at 30°C at reduced pressure. The dried extract was stored in a refrigerator (-4°C) until use.

Processing and Storage

Fresh herbal materials were used for the pharmacognostic evaluation. The collected herbal materials were dried in shade for about 15 days and powdered coarsely in the mill. The powder obtained was passed through # mesh 40 and then used for physicochemical evaluation. The powders were extracted with Ethanol (95%) and the ethanolic extracts were used for phytochemical evaluation.

Selection and Maintenance of Animals

Wistar albino rats of either sex weighing 200-250 g were employed for the study. There were procured from National Institute of Nutrition, Hyderabad, Andhra Pradesh, India. The rats were maintained under standard laboratory conditions at $25\pm 2^{\circ}\text{C}$, relative humidity of $50\pm 15\%$ and normal photo period (12 h dark / 12 h light) were used for the experiment. Commercial pellet diet (Ratan Brothers, India) supplied by and water were provided *ad libitum*. The experimental protocol has been approved by the Institutional Animal Ethics committee and by the Regulatory body of the government (Regd no.1563/PO/a/11/CPCSEA).

Pharmacognostical Evaluation

A systematic Pharmacognostical study was carried out on the herbal drugs selected, to describe them more scientifically and to identify specific characteristics, if any, which will be helpful in the quality assurance and standardization of these herbal drugs^[9-13].

Phytochemical screening

Phytochemical tests were carried out on the powdered sample using standard experimental procedures^[14].

Histological Characters

The transverse section of midrib, stem and stomata of *G. gynandra* were studied^[15].

Evaluation of *G. gynandra* herbal extract on glucose tolerance in rats

Rats were divided in to five groups of six each and fasted overnight and treated as follows.

Group-I (negative control): received distilled water;

Group-II (positive control): received Tolbutamide (40 mg/kg);

Group-III-V (test): received the ethanolic extract of *G. gynandra* herb at doses of 100, 250 and 500 mg/kg as fine aqueous suspension.

After 30 min of extract administration, all the rats were treated with 2.5 g/kg of glucose. All the treatments were administered orally to the rats. Blood sample were collected from the tip of each animal's tail and a drop of fresh blood squeezed out on a sensor pad of a specified strip of the glucose measuring meter (One touch glucometer, USA). This blood collection was done for each animal prior to glucose administration, 30 and 90 min after glucose loading ^[16, 17].

Evaluation of *G. gynandra* herbal extract on alloxan-induced hyperglycemia

All the rats were injected intraperitoneally with Alloxan monohydrate dissolved in sterile normal saline at a dose of 150 mg/kg b.wt. Two weeks after treatment. Thirty rats with moderate diabetes having glycosuria (indicated by Benedict's qualitative test) and hyperglycemia (i.e. with blood glucose of 200- 300 mg/dl) were selected and divided into five groups of six rats. They are treated as follows.

Group I (negative control): given distilled water

Group II (positive control): received Tolbutamide 40 mg/kg

Groups III-V (test): treated with the tested herbal extract at doses of 100, 250 and 500 mg/kg as fine aqueous suspension.

All the treatments were administered orally as before. Blood sample were collected from the tip of each animals tail just prior to and 1 h and 4 h after extract administration.

Sub-acute treatment of *G. gynandra* herbal extract on alloxan- induced diabetic rats

The alloxan induced diabetic rats used above were subjected to sub-acute treatment for ten days. The treatment was as follows.

Group I (negative control): received distilled water

Group II (positive control): received Tolbutamide 40 mg/kg

Groups III-V (test): received the *G. gynandra* herbal extract at doses of 100, 250 and 500 mg/kg as fine aqueous suspension.

As in previous model, all treatments were administered orally. The administration of all treatments continued for 10 days, once daily. The blood samples were collected from the tail vein just prior to and on day 1, 4, 7 and 10 of extract administration. The blood glucose level was determined for all the samples as described before.

Statistical analysis

Data were expressed as the mean \pm SD. Differences in mean blood glucose level between treatments were analysed with the one-way analysis of variance ANOVA, followed by a post hoc of Dunnett's T-test and the statistical significance of the results were considered statistically significant when $P < 0.05$.

RESULTS AND DISCUSSION

Phytochemical characteristics

The coarse powder of *G. gynandra* herb was yellowish brown in colour, which has characteristic odour and has bitter in taste. The extractive values of *G. gynandra* herb was $5.5 \pm 0.113\%$ w/w with Petroleum-ether, $4.6 \pm 0.145\%$ w/w with Chloroform, $7.2 \pm 0.215\%$ w/w with Ethanol and $3.6 \pm 0.051\%$ w/w with water as solvents. The Loss On Drying value was $11.5 \pm 0.128\%$ w/w, the total Ash value was $1.96 \pm 0.117\%$ w/w, the acid-insoluble ash and water soluble Ash were 1.32 ± 0.111 and $0.7 \pm 0.064\%$ w/w respectively. The extracts did not show any Fluorescence. The ethanol extract gave Total Solid Content of $87.58 \pm 5.237\%$ w/w. It gave positive tests for Phytosterols, Triterpenes, Flavonoids, Carbohydrates and Alkaloids. The extract was free from Glycosides, Saponins, Tannins, Proteins and Amino Acids. The phytochemical characteristics of *G. gynandra* herb were shown in Table No 1.

Table No 1: Phytochemical characteristics of *Gynandropsis gynandra* herb

Physical Tests of Crude Drugs	<i>Gynandropsis gynandra</i> herb
Nature	Coarse Powder
Colour	Yellowish Brown
Odour	Characteristic
Taste	Bitter
Extractive values	5.5 ± 0.113 (Petroleum-ether)
(% w/w)	4.6 ± 0.145 (Chloroform)
	7.2 ± 0.215 (Ethanol)
	3.6 ± 0.051 (Aqueous)
Loss On Drying(% w/w)	11.5 ± 0.128
Total Ash(% w/w)	1.96 ± 0.117
Acid-insoluble ash (% w/w)	1.32 ± 0.111
Water-soluble Ash (% w/w)	0.7 ± 0.064
Fluorescence Analysis	No Fluorescence
Total Solid Content (% w/w)	87.58 ± 5.237 (Ethanol Extracts)
Nature	Semi Solid
Color	Light Green
Odour	Characteristic
Taste	Bitter

Ethanollic extracts	
Phytosterols	+
Triterpenes	+
Glycosides	-
Saponins	-
Flavonoids	+
Tannins	-
Proteins & Amino Acids	-
Carbohydrates	+
Alkaloids	+
All values were expressed as mean \pm S.D; Number of trials (n)= 3;	
+ = Positive; - = Negative	

Histological Characters

Midrib of leaf

The transverse section of *G. gynandra* leaf comprises of the following parts namely, Epidermis, Cortex, Endodermis, pericycle, Vascular bundles. (Fig. 1)

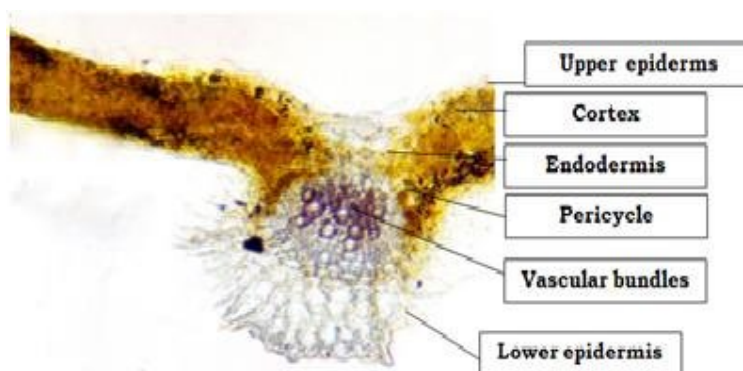


Fig. 1: T.S. of *Gynandropsis gynandra* leaf

Upper epidermis: Includes barrel shaped cells which are closely packed, devoid of chloroplast and possess glandular trichomes.

Cortex: Below the epidermis layers of cortical cells are present which are made up of polygonal parenchymatous cells.

Endodermis: Endodermis is made up of rectangular barrel shaped cells with casparian thickenings.

Pericycle: Below the endodermis three layered pericycle is present which is made up of parenchymatous cells.

Vascular Bundles: A four to five layered phloem tissue is present that is made up of thinwalled phloem parenchymatous cells and phloem companion cells. Xylem tissue is made up of xylem elements, xylem parenchyma and xylem companion cells.

Lower Epidermis: It was made up of polygonal cells which are closely packed together.

Stem

Transverse section of *G. gynandra* stem comprises of epidermis, exodermis, cortex, endodermis and vascular bundles (Fig. 2).

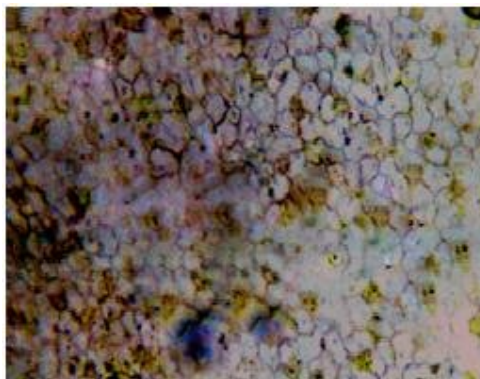


Fig. 2: Epidermis showing Stomata in *Gynandropsis gynandra* Linn

Epidermis: External layer with tightly joined cells that are devoid of stomata. This layer is usually termed as rhizodermis. It is also known as epiblema. This layer with covering trichomes dries and its place is taken by typical secondary boundary tissue called exodermis having glandular trichomes.

Exodermis: This layer is present below the epidermis and is often regarded as a protective layer. The walls of the cells become suberized.

Eames, in 1947, regarded this as hypodermis; Foster and Guttenberg, in 1943, gave it the name exodermis because of the presence of suberin in its walls. The suberin lamella develops on the inner side of the primary wall. They differ from cork cells since they contain protoplasmic contents.

Cortex: The cortex is comparatively simple in histology and is generally composed of thin walled cells with lots of intercellular spaces. The cells are arranged in concentric layers with cells in each layer alternating with others.

Endodermis: It is a distinct layer of cells differentiated from the innermost layer of cortex. The layer is uniseriate, made up of barrel shaped cells. Casparian strips are present radially.

Pericycle: Below the endodermis, a few layers of parenchymatous cells are present which make up the pericycle.

Vascular bundles: The stem exhibits secondary growth, hence a complete ring of cambium is formed. A distinct secondary phloem is visible on the outer side. There is outer fascicular cambium which is made of parenchymatous cells. The phloem consists of phloem fibres, sieve tubes and companion cells. The secondary xylem shows distinct vessels and forms a continuous band interrupted here and there by narrow rays which are uniseriate.

The secondary xylem constitutes a large portion of the bundles; it is present on the inner side and consists of vessels with simple perforated tracheids with a few simple pits on radial walls and some xylem parenchyma.

Pith: Thin walled or thick walled cells filled with tannin and crystals of gypsum constitute the small pith.

Stomata

Anisocytic or cruciferous (unequal) type of stomata which occurs in Capparadaceae family. The stoma is usually surrounded by three or four subsidiary cells, one of which is markedly smaller than the others (Fig. 3).

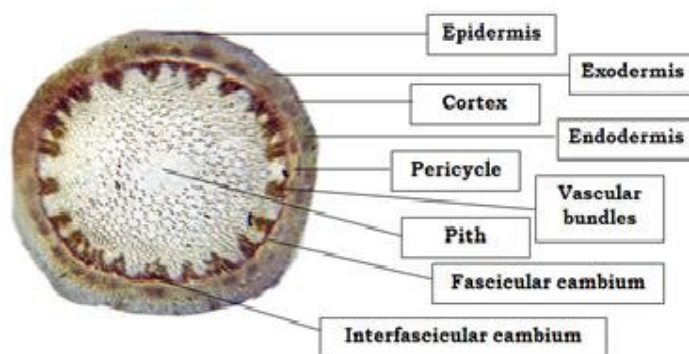


Fig. 3: T.S. of *Gynandropsis gynandra* Linn Stem

Effect of ethanolic extract of *G. gynandra* herbs on blood glucose levels in normal rats

The mean blood glucose levels of control and extract treated animals after oral administration of different doses of ethanolic extract of *G. gynandra* herbs and Tolbutamide at various time intervals are shown in Table No 1. The mean blood glucose levels at various time intervals were statistically evaluated in comparison with initial blood glucose level. The rats treated with 100mg/kg body weight of ethanolic extract of *G. gynandra* herbs produced highly significant reduction [$P < 0.001$] in blood glucose levels at 2, 4, 6 and 8 h while reduction was significant ($P < 0.05$) at 12, 18, and 24 h after oral administration of the extract. The glucose levels of animals treated with 250, and 500 mg/Kg body weight were decreased significantly ($p < 0.001$) at 2, 4, 6, 8, 12 and 18 h. Furthermore, the rats treated with standard drug Tolbutamide (40 mg/kg b. wt.) showed significant reduction in blood glucose up to 12 h.

The mean blood glucose levels produced by 100 mg/kg body weight of ethanolic extract of *G. gynandra* were 99.75 ± 1.4 , 76.04 ± 0.7 , 74.07 ± 0.1 , 80.69 ± 0.5 , 80.22 ± 0.6 and 88.34 ± 0.5 mg/100ml at 0, 2, 4, 6, 8 and 12 h respectively, after the administration of 100 mg/kg body weight of ethanolic extract of *G. gynandra* herbs.

The mean blood glucose levels produced by 250 mg/kg body weight of ethanolic extract were 97.36 ± 0.9 , 74.13 ± 0.8 , 69.28 ± 0.6 , 72.15 ± 0.7 , 76.46 ± 0.4 , 78.54 ± 0.9 , 87.89 ± 0.5 and 89.44 ± 1.7 mg/100 ml at 0, 2, 4, 6, 8 and 12 h respectively. Administration of 500 mg/kg body weight of ethanolic extract of *G. gynandra* herbs produced blood glucose levels of 96.56 ± 0.7 , 79.35 ± 0.6 , 65.23 ± 0.6 , 67.73 ± 0.4 , 71.37 ± 0.4 , 73.95 ± 0.4 , 87.87 ± 0.5 and 88.13 ± 0.2 mg/100ml at 0, 2, 4, 6, 8 and 12 h respectively. The mean blood glucose levels after the administration of Tolbutamide 40 mg/kg b.wt. were 88.44 ± 1.9 , 69.35 ± 1.6 , 52.36 ± 1.2 , 49.13 ± 1.6 , 52.95 ± 1.6 , 63.87 ± 1.4 , 70.52 ± 1.2 and 79.16 ± 0.6 mg /100ml at 0, 2, 4, 6, 8 and 12 h respectively.

The lowest blood glucose levels were observed at 6th h after oral administration of 100, 250 and 500 mg/kg body weight of ethanolic extract of *G. gynandra* herbs. The extract showed hypoglycemic activity in dose dependant manner in normal fasting rats. The onset of hypoglycemic action was found to be very quick and was sustained only up to 8th h. The extract was found to be nearly as potent as the standard drug Tolbutamide in decreasing the blood glucose levels in normal fasting rats.

Effect of ethanolic extract of *G. gynandra* herbs on percent decrease in blood glucose levels with respect to the control group

The mean percent decrease in blood glucose levels produced by different doses of ethanolic extract at various time intervals compared with Sodium CMC suspension treated control group are shown in Table No 2. Oral administration of 100, 250 and 500 mg/kg body weight of ethanolic extract of *G. gynandra* herb produced highly significant ($p < 0.001$) percent reduction in blood glucose at 2, 4, 6, 8 and 12 h compared to the control group at identical times. The standard drug Tolbutamide showed highly significant ($P < 0.001$) decreasing blood glucose up to 12th h. The extent of percent reduction in blood glucose levels for the extract is nearly equal to that of standard.

Oral administration of 100 mg/kg body weight of ethanolic extract of *G. gynandra* herbs showed 23.77, 25.77, 19.15, 19.55 and 11.43 percent reduction in blood glucose at 2, 4, 6, 8 and 12 h compared with control group at identical times. The mean percent decrease in blood glucose levels produced by 250 and 500 mg/kg body weight of the ethanolic extract of *G.*

gynandra herbs at 2, 4, 6, 8 and 12 h were 23.84, 28.87, 25.89, 21.47, 19.32 and 17.82, 32.43, 29.84, 26.11, 23.41 respectively.

Table No 2: Effect of oral administration of ethanolic extract of *G. gynandra* Linn on fasting blood glucose levels on normal rats

Group	Treatment (mg/kg)	Blood glucose levels (mg/dl) at different hours							
		0	2	4	6	8	12	18	24
I	Control (Distilled water)	93.5 ±1.1	91.4±1.3 (2.24)	90.4±1.3 (3.31)*	89.2±1.5 (4.70)	87.4±0.5 (6.09)	85.5±1.5 (8.44)	92.6±1.1 (0.85)	92.7±2.3 (0.96)
II	Tolbutamide- 40	88.5 ±1.9	69.4±1.6 (21.58)	51.6±1.3 (41.55)	48.9±1.6 (45.22)	51.8±1.4 (38.68)	61.5±1.2 (26.66)	68.2±1.1 (21.85)	78.6±0.5 (9.51)
III	<i>G. gynandra</i> - 100	98.8±1.2	75.6±0.6 (24.21)	73.1±0.5 (23.24)*	78.5±0.4 (18.14)	81.5±0.7 (17.48)	87.5±0.4 (10.51)	91.6±0.8 (9.51)	91.6±1.8 (9.48)
IV	<i>G. gynandra</i> - 250	96.5 ±0.7	75.02±0.4 (21.57)	67.1±0.4 (27.55)	71.2±0.5 (26.35)	75.6±0.5 (20.35)	76.6±0.5 (18.24)	86.5±0.8 (10.25)	88.3±1.5 (8.65)
V	<i>G. gynandra</i> - 500	97.8 ±0.4	81.2±0.7 (18.25)	66.9±0.5 (31.56)	65.8±0.5 (31.25)	70.8±0.5 (25.84)	74.2±0.5 (22.51)	86.2±0.6 (9.25)	89.6±0.6 (7.85)

All values are expressed as Mean ± SEM; Values given in the brackets are percent blood glucose reduction.

*** p<0.001 **P<0.01 *P<0.05 Statistically significant compared to 0h of their respective group

Furthermore, the oral administration of the standard drug Tolbutamide 40 mg/kg body weight showed 21.58, 40.79, 44.44, 40.12 and 27.78 percent reduction at 2, 4, 6, 8 and 12 h respectively.

The maximum percent reduction in blood glucose was observed at 6th h as compared to the control group after oral administration of the ethanolic extract of *G. gynandra* herbs. The reduction in blood glucose levels was found to be dose dependant in normal fasting rats. The percent reduction in blood glucose was promising, statistically significant from 2nd h onwards sustained up to 12th h only indicating that the extract is fast acting. The extract showed significant decrease in blood glucose, when compared with standard drug Tolbutamide.

Effect of ethanolic extract of *G. gynandra* herbs on blood glucose levels in Alloxan induced diabetic rats

The mean blood glucose levels were significantly evaluated after the intra peritoneal administration of Alloxan monohydrate. The mean blood glucose levels of control group and other group after oral administration of different doses of ethanolic extract of *G. gynandra* herbs and Tolbutamide in Alloxan induced diabetic rats were shown in Table No 3. The mean blood glucose levels were statistically evaluated by using student's 't' test in comparison to the mean blood glucose levels at 0 h. Oral administration of 0.5ml of 1% sodium CMC suspension to the diabetic rats didn't alter their blood glucose levels at all the time intervals. Oral administration of 100, 250 and 500 mg/kg body weight of ethanolic extract showed

significant decrease ($P<0.001$) in blood glucose levels up to 8th h. Tolbutamide showed significant decrease ($P<0.001$, $P<0.05$) in glucose at the entire time interval. The mean blood glucose levels after the oral administration of 100 mg/kg body weight of ethanolic extract of *G. gynandra* herbs were 259.67 ± 1.7 , 214.16 ± 16.1 , 190.46 ± 3.4 , 208.33 ± 4.4 , 224.17 ± 6.7 , 230.48 ± 13.2 , 247.32 ± 6.7 and 248.97 ± 4.7 mg/100ml at 0, 2, 4, 6, 8 and 12 h respectively. The mean blood glucose levels after administration of 250 and 500mg/kg body weight of ethanolic extract of *G. gynandra* herbs were 304.74 ± 1.9 , 226.65 ± 2.8 , 186.37 ± 5.3 , 218.64 ± 5.5 , 230.82 ± 1.2 , 242.34 ± 8.7 mg/100ml and 324.82 ± 8.8 , 246.72 ± 1.8 , 190.96 ± 14.4 , 218.09 ± 4.2 , 223.35 ± 7.5 and 248.27 ± 6.7 mg/100ml at 0, 2, 4, 6, 8 and 12 h respectively. The mean blood glucose levels after the administration of Tolbutamide 40 mg/kg body weight were 368.54 ± 14.8 , 293.51 ± 0.2 , 225.75 ± 1.2 , 189.23 ± 1.6 , and 222.12 ± 14.8 and 256.67 ± 1.8 mg/100 ml at 0, 2, 4, 6, 8 and 12 h respectively.

Table No 3: Effects of ethanolic extract of *G. gynandra* on fasting blood glucose levels on diabetic rats

Group	Treatment (mg/kg)	Blood glucose levels (mg/dl) at different hours							
		0	2	4	6	8	12	18	24
I	Control	278.8 ± 9.4	272.6 ± 9.3	265.3 ± 6.1	268.8 ± 8.6	269.7 ± 9.6	269.7 ± 9.6	278.2 ± 7.5	281.5 ± 1.5
	(Distilled water)		(3.55)	(3.64)	(5.98)	(5.22)	(3.65)	(1.95)	(2.56)
II	Tolbutamide- 40	365.6 ± 1.1	299.8 ± 9.6	245.6 ± 15.8	179.5 ± 4.2	225.8 ± 8.6	252.1 ± 6.9	298.5 ± 1.2	315.9 ± 2.6
			(25.28)	(31.51)	(49.61)	(35.84)	(31.25)	(12.54)	(18.51)
III	<i>G. gynandra</i> - 100	264.9 ± 19.8	220.5 ± 5.8	201.5 ± 2.5	198.6 ± 1.6	226.8 ± 9.8	238.6 ± 8.5	249.6 ± 7.5	249.5 ± 6.5
			(19.55)	(29.55)	(18.52)	(13.54)	(12.36)	(5.62)	(4.54)
IV	<i>G. gynandra</i> - 250	309.6 ± 1.7	232.5 ± 2.5	188.2 ± 1.5	217.4 ± 6.2	229.5 ± 15.8	240.5 ± 1.2	266.3 ± 1.8	288.4 ± 3.5
			(32.54)	(39.54)	(29.66)	(25.81)	(19.68)	(19.64)	(16.98)
V	<i>G. gynandra</i> - 500	315.3 ± 2.5	248.5 ± 11.2	192.5 ± 12.1	219.4 ± 12.8	225.6 ± 18.7	249.8 ± 15.2	291.2 ± 15.4	312.5 ± 16.9
			(25.21)	(39.51)	(31.24)	(32.54)	(29.68)	(12.38)	(5.84)

All values are expressed as Mean + SEM; Values given in the brackets are percent blood glucose reduction

*** $p<0.001$ ** $P<0.01$ * $P<0.05$ Statistically significant compared to 0h of their respective group.

The extract at all the dose levels i.e. at 100, 250 and 500 mg/kg body weight significantly lowered the evaluated blood glucose levels in Alloxan induced diabetic rats. The lowest blood glucose levels were observed at 4th h after oral administration of the different doses of ethanolic extract. Glucose levels were significantly decreased up to 12th h; whereas the standard drug (Tolbutamide) lowered the blood glucose level to the maximum at 6th h.

Effect of ethanolic extract of *G. gynandra* herbs on percent decrease in blood glucose levels in Alloxan induced diabetic rats with respect to the control group:

The mean percent decrease blood glucose levels of control and the extract treated animals after oral administration of different doses of ethanolic extract of *G. gynandra* herbs at various time intervals are shown in Table No 2.

The mean percent reduction in blood glucose levels was statistically evaluated in comparison to control group at identical time intervals. The mean percent decrease in blood glucose levels produced by all doses were significant ($P < 0.001$, $P < 0.05$) up to 12th h.

The mean percent decrease in blood glucose produced by 100 mg/kg body weight of ethanolic extract of *G. gynandra* herbs were 17.52, 26.65, 19.76, 13.67 and 11.25 at 2, 4, 6, 8 and 12 h respectively. The mean percent decrease in blood glucose level after oral administration of 250 and 500 mg/kg body weight of ethanolic extract of *G. gynandra* herbs were 30.22, 38.85, 28.25, 22.6, 20.47 and 14.47, 41.22, 32.88, 31.23, 23.56 at 2, 4, 6, 8 and 12 h respectively. The oral administration of the standard drug Tolbutamide 40mg/kg body weight showed 20.35, 38.74, 48.65, 39.72 and 30.35 at 2, 4, 6, 8 and 12 h respectively.

The extract at all dose levels showed promising, potent and statistically significant percent decrease in blood glucose. The percent reduction in blood glucose was significant and promising at 2nd h and gradually increased to the maximum level at 6th h and fallen back at 12th h. From these results it was found that the extract is having promising hypoglycaemic activity and more potent anti-hyperglycaemic activity in Alloxan induced diabetic rats. Therefore it is quite obvious that the herb is found to be more potent and having rich traditional use.

CONCLUSION

The coarse powder of *Gynandropsis gynandra* herb was yellowish brown in colour, which has characteristic odour and has bitter in taste. The physic-chemical characteristics were examined. The extract gave positive tests for Phytosterols, Triterpenes, Flavonoids, Carbohydrates and Alkaloids. The extract was free from Glycosides, Saponins, Tannins, Proteins and Amino Acids. The study revealed that the *Gynandropsis gynandra* herb was found to have hypoglycaemic actions similar to standard Tolbutamide drug.

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