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ANTI OBESITY ACTIVITY AND BENEFICIAL EFFECTS OF METHANOLIC EXTRACT OF *DESMOSTACHYA BIPINNATA* IN HFD AND PROGESTERONE INDUCED OBESITY IN RATS AND MICE

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Keywords:

Desmostachya bipinnata, High Fat Diet, Orlistat, Progesterone, Anti-Obesity activity

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ABSTRACT: Obesity is very serious and concerned problem these days. From the first human civilization, research is going to find the drugs to treat obesity and its complications. Despite availability of many drugs in market to treat obesity, no single drug is ideal for treating all sorts of problems caused by obesity. So the research is going on finding perfect drug. Prior going to evaluating drugs on humans, it is necessary to go for preclinical evaluation and usually the rodents are suitable models. The ideal obesity models available for obesity are induced by using chemicals and high fat diet. Methanolic extract of aerial parts of *Desmostachya bipinnata* plant was studied for its Anti-obesity activity in animal experimental models. Wistar albino rats, albino mice were used to study anti-obesity activity of methanolic extract of *D.bipinnata* plant aerial parts at doses 200 mg/kg p.o. and 400 mg/kg p.o. against the standard orlistat 50 mg/kg p.o. in models of anti-obesity activity viz. High fat induced obesity, Progesterone induced obesity model. The induction of obesity is done by diet (20 grams/animal/day) and progesterone (subcutaneous) in High fat induced obesity, Progesterone induced obesity models respectively. The study period is 28 days for both models. In both models, the plant showed anti-obesity activity significantly through the biochemical and behavioral parameters.

INTRODUCTION: Based on Ayurveda, Siddha, Unani systems traditional treatments for various diseases by plant extracts and products is on practice. But there is no sufficient preclinical evaluation studies are present to claim the plants are good at activity.

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From previous studies done on *Desmostachya bipinnta* and due to the presence of effective phytochemical constituents, methanolic extract of the plant aerial parts were selected for evaluating anti-obesity activity. The drug available in market, frequently prescribed and used for treating obesity is orlistat was kept as standard drug. And for obesity, various drugs are available in market and some are under clinical and preclinical phases. Emerging approach for treating obesity is on based on herbal and plant products [1-2]. From literature survey it was found that *Desmostachya bipinnta* effective as diuretic, stimulants, aphrodisiac and used in dysentery and menorrhagia, jaundice,

asthma, uropathy and skin eruptions, Antiulcer genic, antipyretic, analgesic, anti-inflammatory, ant helicobacter activity [3-12]. The study period was 28 days for both models viz. High fat induced obesity, Progesterone induced obesity model. Animals used are male Wistar rats and female albino mice in High fat induced obesity, Progesterone induced obesity models respectively. Before performing the anti-obesity activity of methanolic extract of the plant aerial parts, phytochemical evaluation was done. Progesterone is female reproductive hormone and neuro steroid [13].

Reports are demonstrated that it changes pathophysiology and behavior of organism. It causes excess fat deposition in body. So progesterone was taken as disease control in progesterone induced obesity model. Epidemiological, preclinical studies suggest that there is a direct relationship between amount of diet consumed and obesity occurrence [14]. So the high fat diet was taken as disease control in High fat induced obesity model. The parameters evaluated in studies are biochemical and behavioral in both models.

MATERIALS AND METHODS:

Plant Material Collection:

Aerial parts of *Desmostachya bipinnta* were collected from Tirupati. The plant authentication was done by Department of Botany, Sri Venkateswara University, Tirupathi dist. Chittoor, Andhra Pradesh. Aerial parts of *Desmostachya bipinnta* were dried at room temperature for 2-3 days. The dried aerial parts of *Desmostachya bipinnta* powdered in a mixture. The extraction was done by using the process of soxhlet extraction. 250 grams of fine powder powder was suspended in 400 mL methanol for 48 hours at 65 degrees of temperature soxhlet extractor. After 48 hours the exract was taken and residue was dried [15].

Preliminary Phytochemical Screening:

The methanolic extract ofaerial parts of *Desmostachya bipinnta* were found large percentage of oils, xanthines, flavonoids and carbohydrates, alkaloids, tannins, saponins[17].

Experimental Procedure:

Experimental Animals: Male wistar rats and female albino mice of 150-200 grams and 20-25 grams weighed were used for present study. The animals were housed in polypropylene cage (5 animals per cage), the standard conditions were maintaned (12 hours light and 12 hours dark cycle, 23 ± 5° C and 40-60% humidity). The standard rat and mice pellet, water were provided ad libitum. All the animals were collected from the central animal house SICRA Labs Pvt Ltd, IDA-Kukatpally, Hyderabad and all experiments were conducted according to the ethical norms approved by CPCSEA, Ethical Committee IAEC reg. no. 769/2011/CPCSEA).

Induction of obesity:

By High Fat Diet Method:

The obesity in this model was induced by providing high fat diet 20 grams/day/animal. The study period is 28 days and high fat diet was provided daily.

By Progesterone:

The obesity induced by injection of progesterone through sub cutaneous route for 28 days at dorsal neck region. The dose required for induction is 10 mg/kg and it was prepared by dissolving in arachis oil. 30 minutesprior to the administration of progesterone, test drugs were administered.

Study groups:

In High Fat Diet Model:

Rats were divided into five groups containing 6 animals in each group

Group I: Normal Control fed with normal diet and 2% tween 80 per oral

Group II: Negative Control fed with High Fat diet and 2% tween 80 per oral

Group III: Positive Control fed with High Fat diet and Orlistat 50 mg/kg B.W. per oral

Group IV: Test group (T1) fed with High Fat Diet and 200 mg/kg B.W. MEDB per oral

Group V: Test group (T2) fed with High Fat Diet and 400 mg/kg B.W. MEDB per oral

In Progesterone Induced Obesity Model:

Mice were divided into five groups containing 6 animals in each group

Group I: Normal Control fed with normal diet and 2% tween 80 per oral

Group II: Negative Control treated with Progesterone in arachis oil sub cutaneous

Group III: Positive Control treated with Progesterone in arachis oil sub cutaneous and Orlistat 50 mg/kg B.W. per oral

Group IV: Test group (T1) treated with Progesterone in arachis oil sub cutaneous and 200 mg/kg B.W. MEDB per oral

Group V: Test group (T2) treated with Progesterone in arachis oil sub cutaneous and 400 mg/kg B.W. MEDB per oral

The study was carried out for 28 days. After completion of studies rats and mice were sacrificed, before scarification of animals the blood was collected for biochemical estimation.

Assessment of Food Consumption Behavior in Mice:

In Progesterone induced obesity, it is important to observe food intake. It was observed on 7, 14, 21, 28th days. On these 4 days 30 min after last drug administration, 10 grams of sweetened chow was presented to each group of mice in Petri dishes and food take was recorded at 0.5, 1, 2 hrs time intervals. Rearing, grooming and ambulatory movements were recorded[18].

Biochemical parameters:

On 29th blood was collected from mice and rats by retro orbital puncture method and subjected to TC, TG, LDL-c, VLDL-c, HDL-c, SGOT, SGPT, ALP[19-27] estimations by using prietest biochemical kits by ROBONIK biochemical analyzer.

Statistical Analysis:

The obtained results were expressed as Mean ± SEM. Comparison between control and treatment groups were performed by one way analysis of variance (ANOVA) followed by Dunnets test. The statistical significance criterion was $p< 0.05$ (95% level). $P<0.05$ is considered as significant.

RESULTS:

In High Fat Diet Model:

Rats fed with high fat diet (HFD) showed impairment in normal lipid profile, leading to increased total cholesterol, triglyceride, LDL-C, VLDL-C while HDL-C was decreased. MEDB at 200mg/kg bw showed significant reduction ($p<0.05$), while, MEDB at 400mg/kg bw significantly decreased ($p<0.01$) the total cholesterol levels were highly significant reduction of $p<0.001$ was observed with orlistat at 50mg/kg bw. Significant reduction of triglycerides, $p<0.05$ was seen with MEDB 200 mg/kg bw and the values were found to be <0.01 with MEDB 400 mg/kg bw whereas highly significant reduction $p<0.001$ was seen with orlistat at 50mg/kg bw.

LDL and VLDL were significantly reduced $p<0.05$ with MEDB at 200mg/kg bw but with MEDB 400 mg/kg bw and orlistat at 50mg/kg bw the value of LDL was found to be $p<0.01$.Whereas HDL-C levels were significantly increased with MEDB 400 mg/kg bw and orlistat at 50mg/kg bw $p<0.01$ when compared to normal and untreated groups. Results are mentioned in **Table 2, 3, 4, 5.**

In Progesterone Induced Obesity Model:

There was no significant change in the exploratory behavior of Progesterone control animals as compared to the control group animals but coadministration of MEDB 200 and 400 mg/kg significantly increased the number of ambutations and grooming but not the number of rearing. Mice treated with Progesterone showed impairment in normal lipid profile, leading to increased total cholesterol, triglyceride, LDL-C, VLDL-C while HDL-C was decreased. MEDB at 200mg/kg bw showed significant reduction ($p<0.01$), while, MEDB at 400mg/kg bw significantly decreased ($p<0.05$) the total cholesterol levels were highly significant reduction of $p<0.01$ was observed with orlistat at 10mg/kg bw. Significant reduction of triglycerides, $p<0.05$ was seen with MEDB 200 mg/kg bw and the values were found to be <0.05 with MEDB 400 mg/kg bw whereas highly significant reduction $p<0.01$ was seen with orlistat at 10 mg/kg bw.

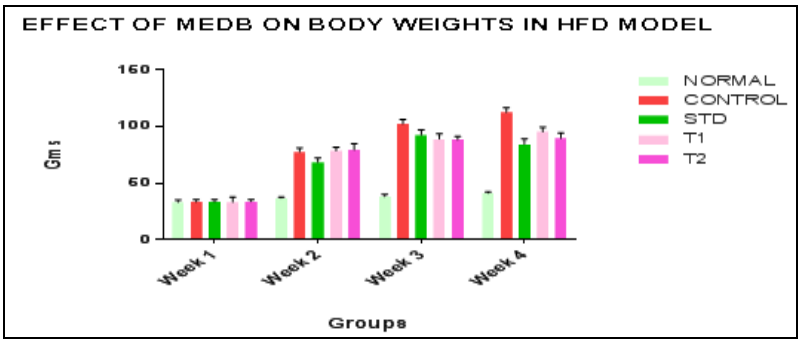
LDL and VLDL were significantly reduced $p<0.01$ with MEDB at 200mg/kg bw but with MEDB 400 mg/kg bw and orlistat at 10mg/kg bw the value of LDL was found to be $p<0.05$.Whereas HDL-C levels were significantly increased with MEDB 400 mg/kg bw and orlistat at 10 mg/kg bw $p<0.05$ when compared to normal and untreated groups. Results are mentioned in **Table 6, 7, 8, 9, 10, 11.**

TABLE 1 PRELIMINARY PHYTOCHEMICAL ANALYSIS:

Name of the Test	Results
Carbohydrates	++
Steroids	—
Alkaloids	++
Glycosides	++
Tannins	–
Flavonoids	—
Saponins	++
Gums	—

TABLE 2: EFFECT OF MEDB ON BODY WEIGHTS OF RATS (HFD MODEL)

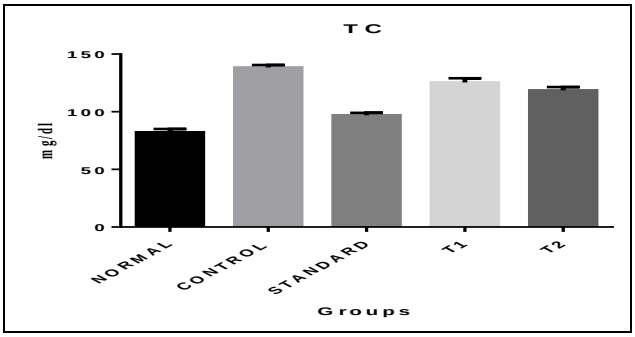
	Differences in body weights (gm) (Mean ± SEM)			
Group (n=5)	**Week 1**	**Week 2**	**Week 3**	**Week 4**
Group I Normal control group	33.2 ± 1.92	36.8 ± 0.9	38.2 ± 1.9	41.20 ± 1.0
Group II Negative control group HFD	33.4 ± 1.89	77.6 ± 3.5	102.3 ± 4.0	112.6 ± 3.9
Group III Positive control group Orlistat 50mg/kg b.w. p.o	33.4 ± 1.86	68.4 ± 3.8	92.6 ± 4.5	84.4 ± 4.6
Group IV T_1 – MEDB 200mg/kg b.w. p.o	33.2 ± 4.5	79.6 ± 3.1	99.1 ± 4.3	95.3 ± 4.1
Group V T_2 – MEDB 400mg/kg b.w. p.o	33.8 ± 1.6	77.4 ± 5.4	97.4 ± 2.8	89.54 ± 4.8

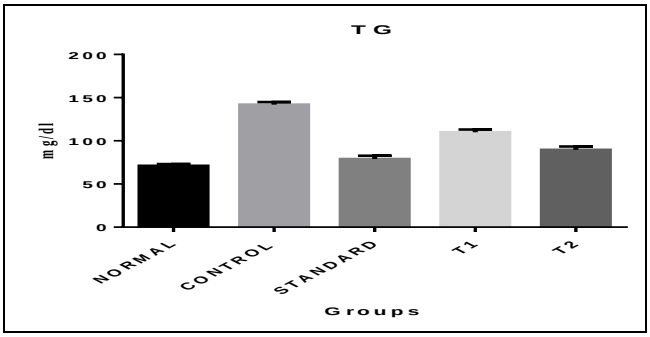


GRAPH 1: EFFECT OF MEDB ON BODY WEIGHTS OF RATS

Table 3 Effect of MEDB on Total Cholesterol and Triglyceride levels in HFD rats

Groups (n = 5)	Total Cholesterol (mg/dl) Mean ± SEM	Triglycerides(mg/dl) Mean ± SEM
Group I-Normal control	82.13 ± 2.98	71.05 ± 1.98
Group II-Negative control(HFD)	138.43 ± 2.13	141.87 ± 3.12
Group III-Positive control Orlistat 50mg/kg b.w. p.o	96.98 ± 2.04***	78.91 ± 3.89***
Group IV T_1 – MEDB 200mg/kg b.w. p.o	125.43 ± 3.65*	109.98 ± 3.16*
Group V T_2 – MEDB 400mg/kg b.w. p.o.	118.5 ± 2.91**	89.63 ± 3.87**

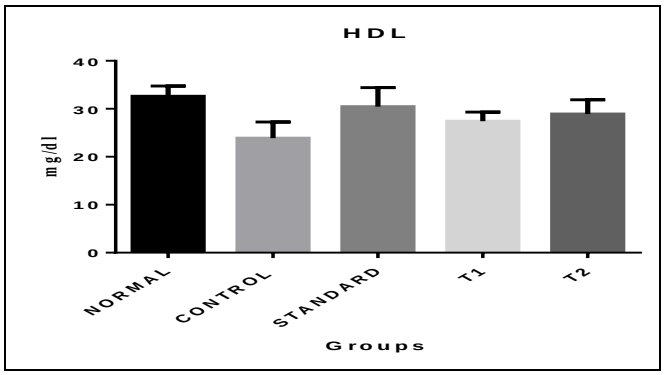


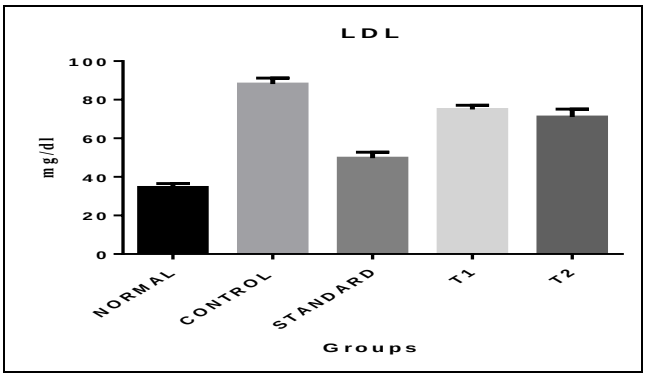


GRAPH 2 AND 3: EFFECT OF MEDB ON TOTAL CHOLESTEROL& TRIGLYCERIDES OF RATS (HFD MODEL)

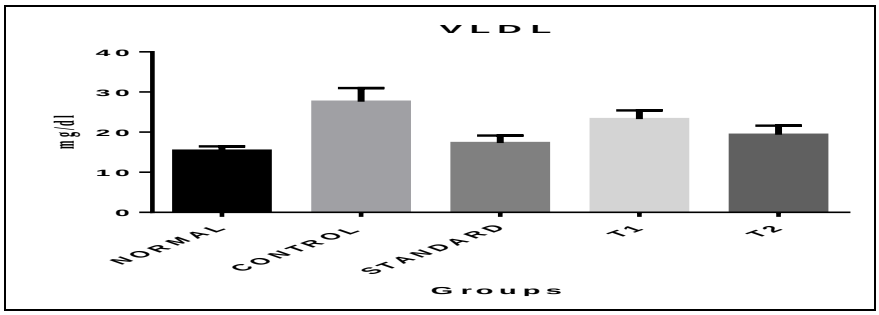
TABLE 4: EFFECT OF MEDB ON HDL, LDL AND VLDL LEVELS IN RATS

Groups (n = 5)	HDL(mg/dl) Mean ± SEM	LDL(mg/dl) Mean ± SEM	VLDL(mg/dl) Mean ± SEM
Group I Normal control	32.62 ± 2.12	34.54 ± 2.01	15.39 ± 1.07
Group II Negative control HFD	23.87 ± 3.39	88.09 ± 3.12	27.59 ± 3.39
Group III Positive control Orlistat 50mg/kg b.w. p.o	30.45 ± 3.97**	49.67 ± 3.96**	17.29 ± 1.87**
Group IV T_1 – MEDB 200mg/kg b.w. p.o	27.42 ± 1.89*	74.98 ± 2.12*	23.24 ± 1.18*
Group VT_2 – MEDB 400mg/kg b.w. p.o	28.91 ± 2.98**	71.02 ± 4.14**	19.36 ± 2.25**





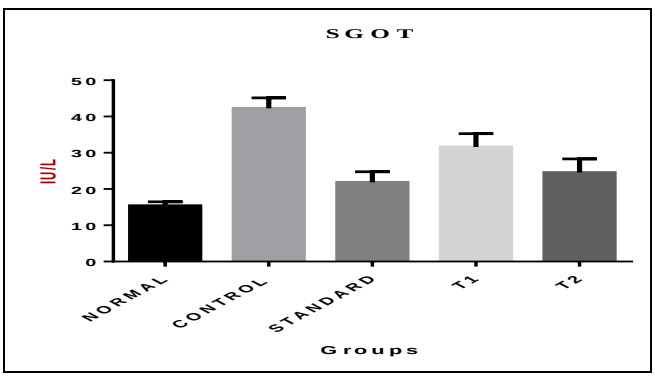
GRAPH 3AND 4: EFFECT OF MEDB ON HDL & LDL OF RATS (HFD MODEL)

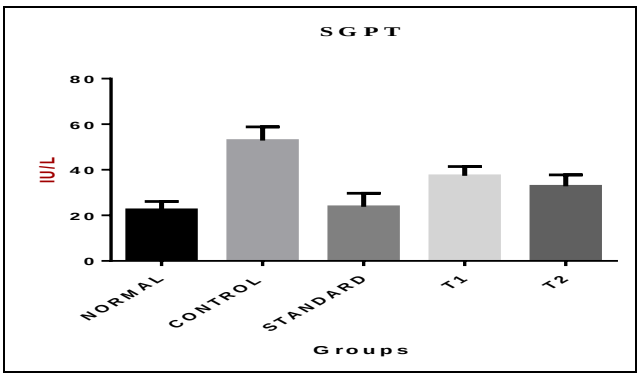


GRAPH 5: EFFECT OF MEDB ON VLDL OF RATS (HFD MODEL)

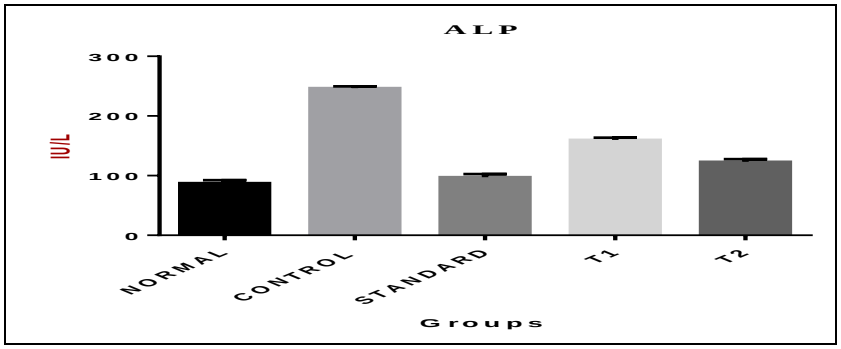
TABLE 5: EFFECT OF MEDB ON SGOT, SGPT AND ALP LEVELS IN RATS

Groups (n = 5)	SGOT(IU/L) Mean ± SEM	SGPT (IU/L) Mean ± SEM	ALP (IU/L) Mean ± SEM
Group I Normal control	17.34 ± 3.67	22.42 ± 3.65	87.49 ± 4.93
Group II Negative control HFD	42.28 ± 2.87	52.85 ± 5.98	246.59 ± 2.98
Group III Positive control Orlistat 50mg/kg b.w. p.o	21.84 ± 2.91**	23.78 ± 5.92**	97.31 ± 5.24***
Group IVT_1 – MEDB 200mg/kg b.w. p.o	31.59 ± 3.66*	37.39 ± 4.03*	159.93 ± 3.61**
Group VT_2 – MEDB 400mg/kg b.w. p.o	24.56 ± 3.75**	32.78 ± 5.02**	123.09 ± 4.63**





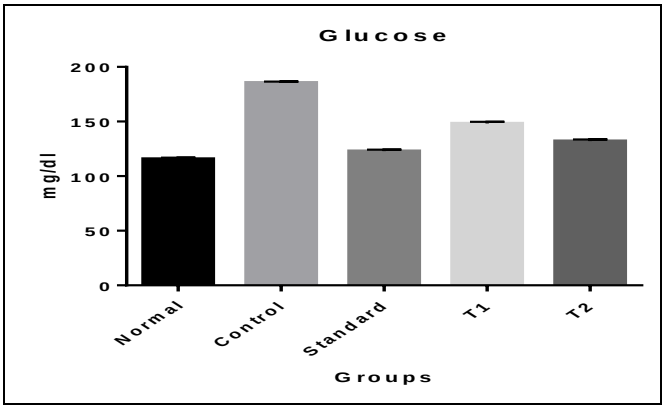
GRAPH 6 AND 7: EFFECT OF MEDB ON SGOT, SGPT OF RATS (HFD MODEL)

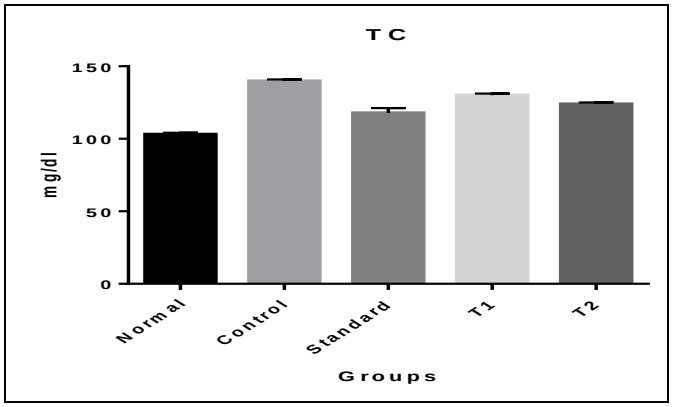


GRAPH 8: EFFECT OF MEDB ON ALP OF RATS (HFD MODEL)

TABLE 6: EFFECT OF GLUCOSE AND TOTAL CHOLESTEROL LEVELS IN MICE(PROGESTERONE METHOD)

Groups (n = 5)	Glucose (mg/dl)Mean ± SEM	TC(mg/dl)Mean ± SEM
Group INormal control	115.81 ± 1.16	103.03 ± 1.19
Group IINegative control (Progesterone)	185.50 ± 1.09	131.92 ± 1.12
Group IIIPositive control Orlistat 10mg/kg b.w. p.o	122.93 ± 1.31***	117.83 ± 3.3***
Group IV T_1 – MEDB 200mg/kg b.w. p.o	148.33 ± 1.47***	130.06 ± 1.16**
Group V T_2 – MEDB 400mg/kg b.w. p.o.	132.1 ± 1.42***	123.91 ±1.1***

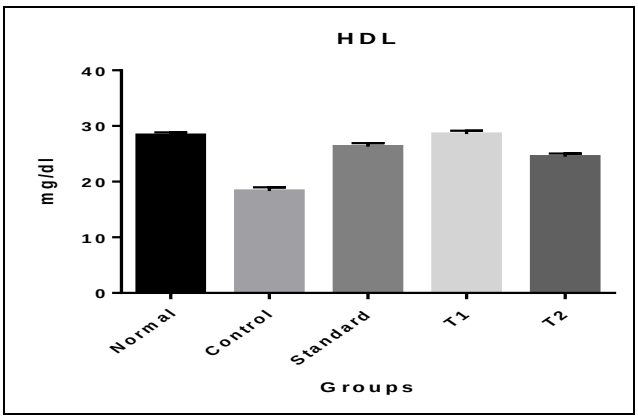


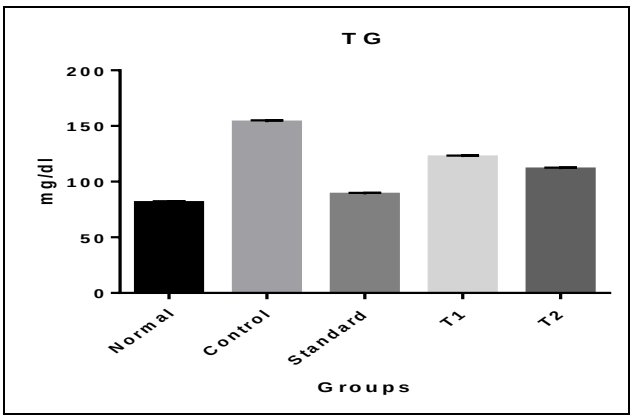


GRAPH 9 AND 10: EFFECT OF MEDB ON GLUCOSE AND TOTAL CHOLESTEROL OF MICE (PROGESTERONE INDUCED MODEL)

TABLE 7: EFFECT OF HDL AND TRIGLYCERIDESL LEVELS IN MICE

Groups (n = 5)	HDL(mg/dl) Mean ± SEM	TG (mg/dl) Mean ± SEM
Group I Normal control	28.34 ± .52	81.09 ± 1.25
Group II Negative control (Progesterone)	18.31 ± .67	153.46 ± 1.55
Group III Positive control Orlistat 10mg/kg b.w. p.o	26.29 ± .61***	88.62 ± 1.24***
Group IV T_1 – MEDB 200mg/kg b.w. p.o	28.56 ± .59***	122.06 ± 1.43***
Group V T_2 – MEDB 400mg/kg b.w. p.o.	24.48 ± .57***	111.22 ±1.34***

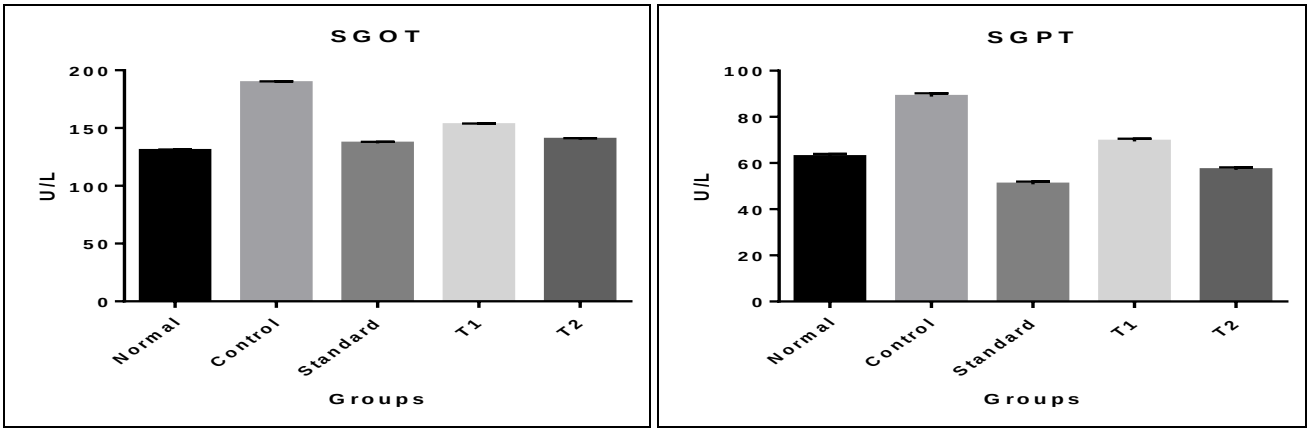




GRAPH 11AND 12: EFFECT OF MEDB ON HDL &TRIGLYCERIDES OF MICE (PROGESTERONE INDUCED MODEL)

TABLE 8: EFFECT OF SGOT AND SGPT LEVELS IN MICE

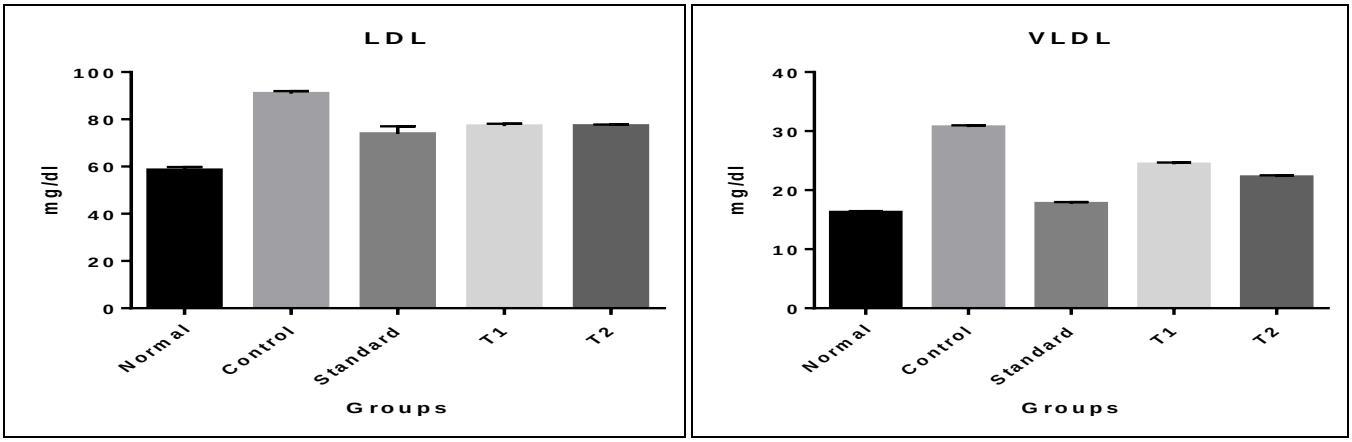
Groups (n = 5)	SGOT (mg/dl) Mean ± SEM	SGPT(mg/dl) Mean ± SEM
Group INormal control	130.43 ± .92	62.67 ± 1.26
Group IINegative control(Progesterone)	189.08 ± 1.26	88.83 ± 1.36
Group IIIPositive controlOrlistat 10mg/kg b.w. p.o	136.8 ± 1.21***	50.83 ±1.14***
Group IVT_1 – MEDB 200mg/kg b.w. p.o	152.68 ± 1.17***	69.36 ±1.19 ***
Group VT_2 – MEDB 400mg/kg b.w. p.o.	140.01 ±1.19***\	57.04 ±1.10***



GRAPH 13AND14: EFFECT OF SGOT AND SGPT LEVELS IN MICE

TABLE 8: EFFECT OF LDL AND VLDL LEVELS IN MICE(PROGESTERONE INDUCED MODEL)

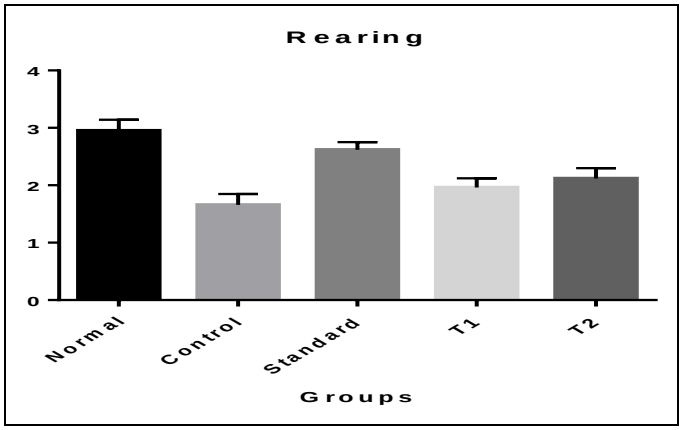
Groups (n = 5)	VLDL(mg/dl) Mean ± SEM	LDL(mg/dl) Mean ± SEM
Group I Normal control	16.2 ± .25	58.48 ± 1.32
Group IINegative control(Progesterone)	30.69 ± .30	90.91 ± 1.03
Group III Positive control Orlistat 10mg/kg b.w. p.o	17.72 ± .25***	73.81 ±3.24***
Group IVT1 – MEDB 200mg/kg b.w. p.o	24.39 ± .28***	77.11 ±1.05 ***
Group VT2 – MEDB 400mg/kg b.w. p.o.	22.23 ±.27***	77.19±.62***

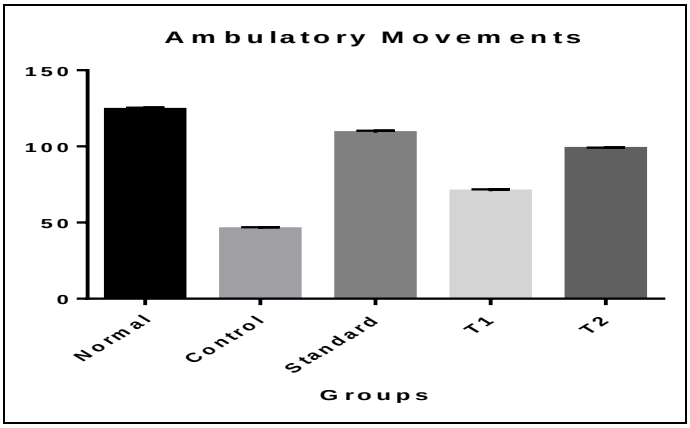


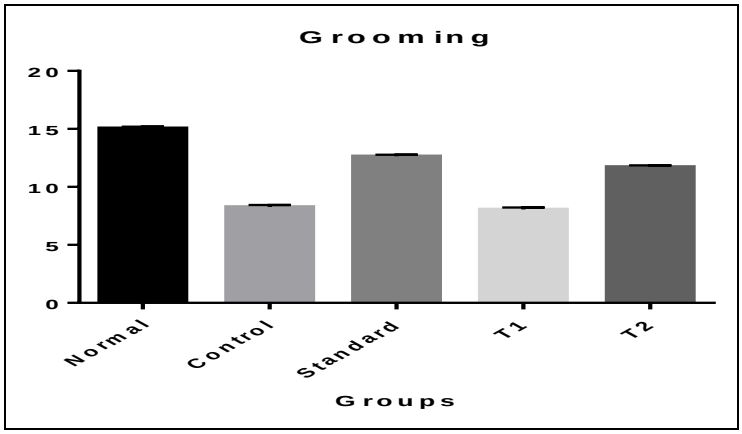
GRAPH 15 AND 16: EFFECT OF LDL AND VLDL LEVELS IN MICE

TABLE 9: EFFECT OF BEHAVIORAL PARAMETERS IN MICE(PROGESTERONE INDUCED MODEL)

Groups (n = 5)	Ambulatory movements (mg/dl) Mean ± SEM	Rearing (mg/dl) Mean ± SEM	Grooming (mg/dl) Mean ± SEM
Group I Normal control	124.18 ±1 .25	2.95 ± .19	15.06 ± .13
Group II Negative control(Progesterone)	45.77 ±1.12	1.66 ± .19	8.27 ±.17
Group III Positive control Orlistat 10mg/kg b.w. p.o	108.94 ± 1.31***	2.62 ±.13**	12.64±.14***
Group IVT1 – MEDB 200mg/kg b.w. p.o	70.57 ± 1.21***	1.96 ±.16 NS	8.05 ±.18NS
Group VT2 – MEDB 400mg/kg b.w. p.o.	98.56 ±1.21***	2.12±.18NS	11.72±.14***



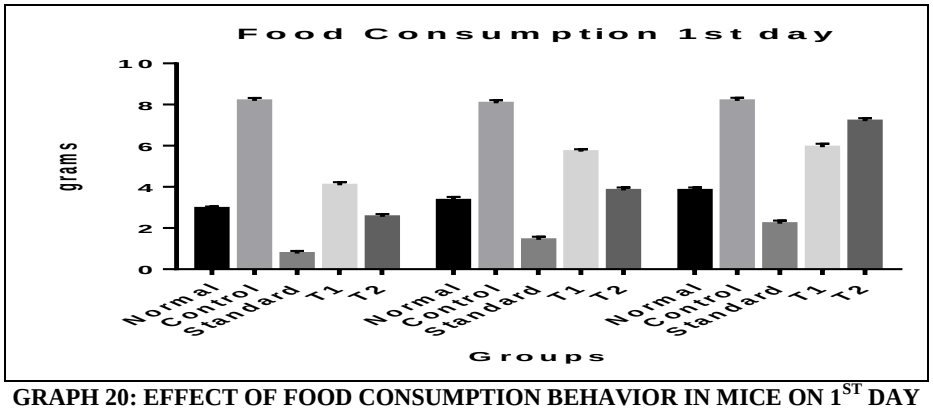




GRAPH 17, 18 AND 19: EFFECT OF BEHAVIORAL PARAMETERS IN MICE

TABLE 10: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 1ST DAY

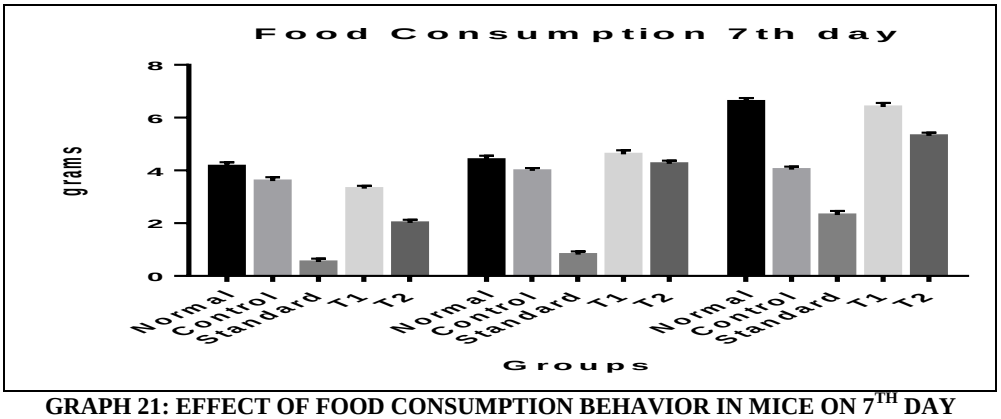
Groups (n = 5)	0.5hr	1hr	2hr
Group I Normal control	2.95 ± .1	3.35 ± 1.16	3.83 ± .14
Group II Negative control (Progesterone)	8.18 ± 1.14	8.06 ± 1.15	8.18 ± .15
Group III Positive control Orlistat 10mg/kg b.w. p.o	.76 ± .13***	1.43 ± 1.15***	2.21 ± .15***
Group IV T1 – MEDB 200mg/kg b.w. p.o	4.08 ± .15***	5.71 ± .12***	5.93 ± .17***
Group V T2 – MEDB 400mg/kg b.w. p.o.	2.55 ± .13***	3.83 ± .14***	7.2 ± .14***



GRAPH 20: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 1ST DAY

TABLE 10: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 7TH DAY

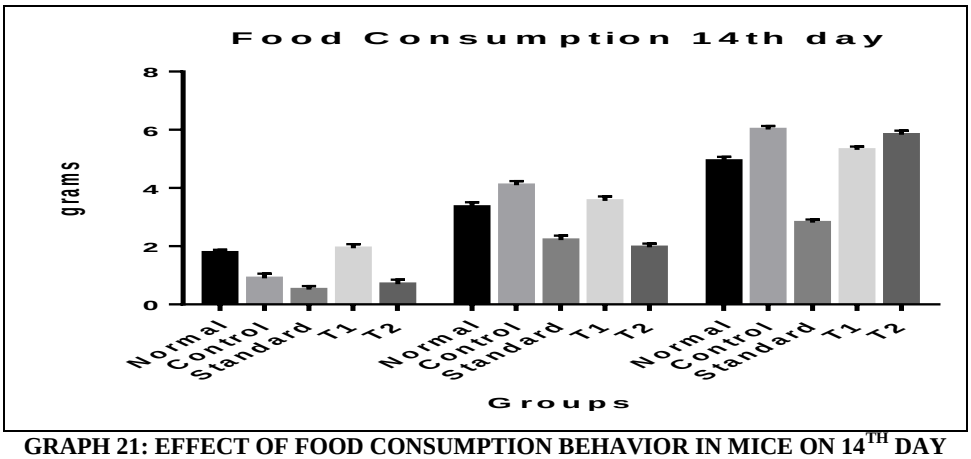
Groups (n = 5)	0.5hr	1hr	2hr
Group I Normal control	4.16 ± .15	4.4 ± .16	6.61 ± .13
Group II Negative control(Progesterone)	3.6 ± .14	3.98± .11	4.03 ± .11
Group III Positive control Orlistat 10mg/kg b.w. p.o	.53 ± .13***	.81 ±.12***	2.31 ± .15***
Group IV T1 – MEDB 200mg/kg b.w. p.o	3.31 ± .11	4.61 ± .15*	6.4 ± .16***
Group VT2 – MEDB 400mg/kg b.w. p.o.	2.01 ± .12***	4.25 ± .12	5.31 ± .12***



GRAPH 21: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 7TH DAY

TABLE 11: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 14TH DAY

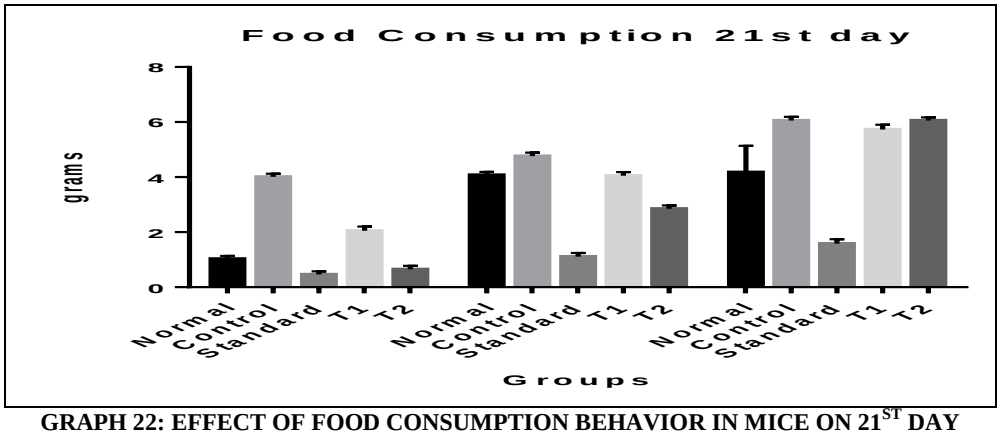
Groups (n = 5)	0.5hr	1hr	2hr
Group I Normal control	1.78± .1	3.35 ± .16	4.93 ± .14
Group II Negative control (Progesterone)	.9 ± .16	4.1± .14	6.01 ± .12
Group III Positive control Orlistat 10mg/kg b.w. p.o	.51 ± .12	2.21 ±.15***	2.81 ± .11***
Group IV T1 – MEDB 200mg/kg b.w. p.o	1.93 ± .14***	3.56 ± .15	5.31 ± .11**
Group V T2 – MEDB 400mg/kg b.w. p.o.	.7 ± .15	1.96 ± .13***	5.83 ± .14



GRAPH 21: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 14TH DAY

TABLE 12: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 21ST DAY

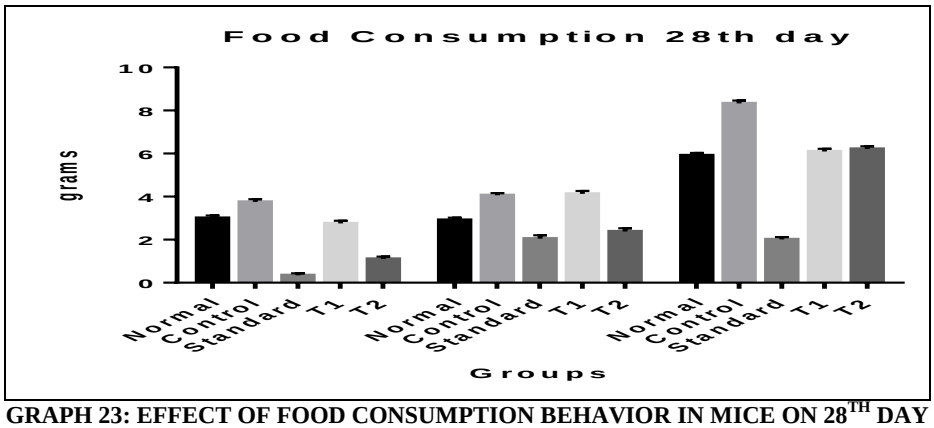
Groups (n = 5)	0.5hr	1hr	2hr
Group I Normal control	1.03± .11	4.08 ± .11	4.18 ± .09
Group II Negative control(Progesterone)	4.01 ± .11	4.76± .13	6.06 ± .13
Group III Positive control Orlistat 10mg/kg b.w. p.o	.46 ± .12***	1.11 ±.13***	1.58 ± .16***
Group IVT1 – MEDB 200mg/kg b.w. p.o	2.05 ± .15***	4.05 ± .13**	5.73 ± .17
Group VT2 – MEDB 400mg/kg b.w. p.o.	.65± .13***	2.85 ± .12***	6.06 ± .11



GRAPH 22: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 21ST DAY

TABLE 13: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 28TH DAY

Groups (n = 5)	0.5hr	1hr	2hr
Group I Normal control	3± .12	2.91 ± .11	5.91 ± .12
Group II Negative control(Progesterone)	3.75 ± .13	4.06± .10	8.33 ± .13
Group IIIPositive control Orlistat 10mg/kg b.w. p.o	.35 ± .09***	2.05 ±.15***	2.01 ± .11***
Group IVT1 – MEDB 200mg/kg b.w. p.o	2.75 ± .13***	4.13 ± .13	6.1 ± .12***
Group VT2 – MEDB 400mg/kg b.w. p.o.	1.1± .11***	2.38 ± .15***	6.21 ± .13***



GRAPH 23: EFFECT OF FOOD CONSUMPTION BEHAVIOR IN MICE ON 28TH DAY

DISCUSSION: In the present study, the anti-obesity activity of methanolic extract of aerial parts of *Desmostachya bipinnata* (MEDB) was studied using dietary animal's model of obesity. There was significant increase in the body weight in High fat diet (HFD) treated animals, which was significantly decreased by the administration of MEDB and Orlistat.

The investigation revealed that both models causes increase in serum lipid profiles: Total cholesterol, Triglycerides, LDL and VLDL with decrease in HDL and the liver function test also showed Increase in SGOT SGPT and ALP levels. However, there was significant decrease in TG, TC, LDL, VLDL, SGOT, SGPT and ALP with increase in HDL levels. This may be attributed to the action of MEDB 400mg/kg BW p.o and Orlistat 50mg/kg BW p.o.

A significant increase in serum HDL levels in animals treated with MEDB 400mg/kg b.w.p.o was observed. Considering the enhancement of cardio protective lipid HDL, it can be concluded that the MEDB is not only anti obesity and anti hyperlipidemia agent but also a cardio protective agent.

MEDB at 400mg/kg B.W .p.o showed cardio protection by decreasing the atherogenic index and provided high % hyperlipidemia, which points out the reduction in risk against cardiovascular diseases. The livers of untreated rats were found to be yellow and bulky. Histopathological results revealed signs of fat accumulation indicating steatosis. Whereas, the condition was reversed in rats treated with MEDB 400mg/kg b.w. p.o. and orlistat 50mg/kg b.w. p.o.

It is believed that progesterone producing hyperphagia via progestin receptors which have been reported to be expressed on the serotonergic neurons & orlistat suppresses the progesterone induced hyperphagia by inhibiting reuptake of 5-HT (serotonin) at the hypothalamic site which regulate the food intake, which suggests the possible interaction exists between the neurosteroid and serotonin receptor system in regulating food intake and body weight. Further, these data implicate that disturbances in the ovarian hormone levels may predispose females to eating disorders by causing alterations in the serotonin level or serotonergic receptor function.

In this study administration of Progesterone to the control animals caused significant increase in the food consumption at 30 min, 1hr and 2hr which was significantly reduced by the administration of MEDB (200 mg/kg), MEDB at 1hr as compared to the disease control animals. Whereas MEDB (400 mg/kg) and the standard Orlistat significantly decreased the food consumption at 30 min, 1hr and 2hr as compared to both normal control as well as disease controls.

Saponin inhibits pancreatic lipase. Pancreatic lipase, a key enzyme, which is responsible for hydrolysis of a majority of dietary fats, may be targeted for the concerned obesity pandemic. It is responsible for hydrolysis of 50-60% of total dietary fats. The two main products formed by the hydrolysis of pancreatic lipase are fatty acids and 2-monoacylglycerols. These products combine with bile salts, dispersed as micelles and carried in this form to the site of absorption. Lipid absorption takes place in the apical part of the plasma membrane of epithelial cells, so inhibition of this enzyme may cause decrease in fat absorption. It can be anticipated that the lipid lowering mechanism may also enhanced removal or catabolism of lipoproteins, inhibition of HMG CO-A Reductase, and or inhibition of lysosomal lipid hydrolytic enzymes secreted by the liver.

Apart from being antioxidants, flavonoids have been reported to inhibit sodium-dependent vitamin C transporter 1 and glucose transport Isoform 2 (Glut 2), the intestinal transporter for vitamin C and glucose, leading to a decrease in the intestinal absorption of glucose, hence decrease in the blood glucose concentration [27]. Several researches have also demonstrated that flavonoids act as reducer of hyperglycemia by causing inhibition of renal glucose reabsorption through inhibition of the sodium-glucose symporters located in the proximal renal convoluted tubule .[28-30]

Saponins are known anti nutritional factors, which lower cholesterol by binding with cholesterol in the intestinal lumen, preventing its absorption, and/or by binding with bile acids, causing a reduction in the enterohepatic circulation of bile acids and increase its fecal excretion [31].

The administration of Progesterone caused significant increase in food intake compared to the control group animals which was significantly decreased by co-administration of MEDB 200 and 400 mg/kg Standard Orlistat was found to be more significant in this case

As far as effect on exploratory behavior of Progesterone animals is concerned, there was no significant change in the exploratory behavior of Progesterone control animals as comparedto the control group animals but co-administration of MEDB 200 and 400 mg/kg significantly increased the number of ambulation's and groomingbut not the number of rearing.

By the phytochemical investigation it was found that *Desmostachya bipinnata* contains carbohydrates, flavonoids, glycosides and oils, saponins, alkaloids and tannins. It was reported that carbohydrates, flavonoids, glycosides and oils, saponins, alkaloids and tannins reduces cholesterol levels and have antioxidants activity. The plant *Desmostachya bipinnata* was found to be useful in treatment of obesity and hyperlipidemia may be due to the presence of above mentioned phytoconstituents.

CONCLUSION: On evaluating behavioral and biochemical parameters, it was found that the methanolic extract of aerial parts of *Desmostachya bipinnata* showed anti-obesity activity in both High fat induced obesity, Progesterone induced obesity models by showing protective activity.

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