



ELSEVIER

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Data of antihyperlipidaemic activity for methanolic extract of *Tagetes patula* Linn. flower head along with piperine, as bioavailability enhancer



Sneha Nawale^{a,*}, K. Padma Priya^b, P. Pranusha^c,
M. Ganga Raju^c

^a Department of Pharmacognosy, Gokaraju Rangaraju College of Pharmacy, Bachupally, Hyderabad 500090, India

^b Gokaraju Rangaraju College of Pharmacy, Bachupally, Hyderabad 500090, India

^c Department of Pharmacology, Gokaraju Rangaraju College of Pharmacy, Bachupally, Hyderabad 500090, India

ARTICLE INFO

Article history:

Received 14 May 2018

Received in revised form

4 October 2018

Accepted 5 October 2018

Available online 13 October 2018

Keywords:

Antihyperlipidemic activity

Tagetes patula

Piperine

Triton X-100

Bioavailability

GC–MS

ABSTRACT

The data present in this article is associated with influence of piperine (secondary metabolite) on the antihyperlipidemic and antioxidant activity of methanolic extract of *Tagetes patula* (METP). METP was evaluated for antihyperlipidemic and antioxidant potential. Phytoconstituents of METP were identified using gas chromatography linked with a mass spectrometer. *in vivo* antihyperlipidemic activity of METP at the dose of 200 and 400 mg/kg b. wt. and 200 and 400 mg/kg b. wt. along with piperine (20 mg/kg b. wt.) were evaluated by Propylthiouracil induced and Triton X-100 induced hyperlipidemia in rats. Propylthiouracil significantly increased the serum TC ($p < 0.01$), TG ($p < 0.01$), LDL ($p < 0.01$) and VLDL ($p < 0.01$) levels and induction of HDL ($p < 0.01$) at a dose of 400 mg/kg b. wt. along with piperine. Triton X-100 at a single dose of *i.p* increased lipid levels within 48 h. Increased lipid levels were significantly reduced TC ($p < 0.01$), TG ($p < 0.01$), LDL ($p < 0.05$) and VLDL ($p < 0.05$) by METP at doses of 200 and 400 mg/kg b. wt. along

Abbreviations: METP, Methanolic extract of *Tagetes patula* flower heads; GC–MS, gas chromatography and mass spectrometry; NO, nitric oxide; IAEC, Institutional Animal Ethical Committee; CPCSEA, Committee for the purpose of control and supervision of experimentation on animals; OECD, Economic Cooperation and Development; *i.p*, intra-peritoneal; *p.o*, per oral; PTU, propylthiouracil; ANOVA, Analysis of variance; ROS, Reactive oxygen species; b. wt, body weight; TC, total cholesterol; TG, triglycerides; HDL, high density lipoprotein; LDL, low density lipoprotein; VLDL, very low density lipoprotein; SEM, standard error of mean

* Corresponding author.

E-mail address: sneha.nawale11@gmail.com (S. Nawale).

<https://doi.org/10.1016/j.dib.2018.10.022>

2352-3409/© 2018 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

with piperine. Current data were also supported by histological study of livers, Cord pattern of hepatocytes, few periportal lymphocytes in focal area observed in hyperlipidemic rats and hepatocyte, periportal and centrilobular region of liver appear normal in treated group. METP along with piperine (capability to enhance bioavailability and has a property of increasing oral absorption of drugs) showed promising antioxidant and antihyperlipidemic activity which suggests the further use of *Tagetes patula* extract for the management of hyperlipidemia and atherosclerosis.

© 2018 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license

(<http://creativecommons.org/licenses/by/4.0/>).

Specifications table

Subject area	Pharmacy
More specific subject area	Antihyperlipidemic activity of medicinal plant
Type of data	Table, text file, graph, figure
How data was acquired	Gas chromatography and mass spectroscopy was performed on Agilent 6890 series GC–MS instrument with HP-5MS Column (dimensions 30m• ~0.32mm• ~0.25µm) and semi auto analyser.
Data format	Analysed
Experimental features	Total cholesterol, triglyceride, HDL, LDL and VLDL was measured for METP(200 mg/kg bd.wt) METP(200 mg/kg bd.wt + piperine), METP (400 mg/kg bd.wt) and METP(400 mg/kg bd.wt + piperine)for triton induced and PTU induced hyperlipidaemia animal models.
Experimental factors	Methanol extract of flowers of the <i>Tagetes patula</i> was prepared By soxhlet extract assembly <ol style="list-style-type: none"> 1. The acute toxicity data for methanol extract of flower heads. 2. Was performed by using female mice followed by OECD guidelines 425. Hyperlipidaemia was induced with propylthiouracil of 10 mg kg⁻¹ b. wt. dosage and 0.01% PTU in drinking water for 7 days. 3. Rats were divided into seven groups of six rats (n=6) each. The Group I and II served as normal control and disease control, respectively receives saline (0.2 ml oral). Group III and IV, were treated with METP and Group V and VI were treated with METP along with piperine. The Group VII served as standard
Data source location	Department of Pharmacology, Gokaraju Rangaraju College of Pharmacy, Bachupally, Hyderabad-500090, Telanagana.
Data accessibility	All data are given along with the article and also provided in NCBI repository.
Related Research articles	<ol style="list-style-type: none"> 1. Xin Di, Xin Wang, Xin Di, Youping. Effect of piperine on the bioavailability and pharmacokinetics of emodin in rats Linn. <i>J Pharma Biomed Anal</i>, 115 (2015): 144-49). 2. Jabeen A., M. Ahmed, S. U. Simjee, Lubna, Samina B., S. Faizi. Anti-TNF-α and anti-arthritic effect of patuletin: A rare flavonoid from <i>Tagetes patula</i>. <i>Int Immunopharmacol.</i>, 36 (2016): 232-40. 3. N. S. Adigun, A. T. Oladiji, T.O. Ajiboye. Antioxidant and anitihyperlipidaemic activity of hydroalcoholic seed extract of <i>Aframomum melegueta</i> K. Schum in triton X-100 induced hyperlipidemic rats. <i>South Afri J Botany</i>, 105(2016): 324-32.

Value of the data

- The methods and data can be used to study *Tagetes patula* for its antihyperlipidaemic property studied in detail.
 - Comparison of antihyperlipidaemic activity data of METP (200 and 400 mg/kg bd.wt.) alone and along with piperine (20 mg/kg bd.wt) as penetration enhancer also gives reference for researchers for formulation studies.
 - GC–MS data and *in vitro* antioxidant activity data of METP also provide valuable reference to compare secondary metabolite and their action as antihyperlipidaemic activity. Furthermore Nutritional ingestion of this plant species will put in innovative scope in the managing of hyperlipidemia and other metabolic disorders.
-

1. Data

The present data focuses on antihyperlipidemic capability of *Tagetes patula* Linn. *Tagetes patula* Linn. (French marigold) belongs to the family Asteraceae is widely known for its phytochemical and medicinal properties. The data on chemical composition of methanolic extract *Tagetes patula* Linn was done by gas chromatography and mass spectrometry are shown in Fig. 1 and Table 1. Information regarding changes in lipid profile (TC, TG, LDL, VLDL and HDL) for PUC and triton induced antihyperlipidemic are presented in Table 2 (Fig. 2) and Table 3 (Fig. 3) respectively. Data regarding histological changes of rat hepatocytes of liver are shown in Figs. 4 to 10. The present investigation helps in finding the influence of piperine on antihyperlipidemic activity of *Tagetes patula*.

2. Experimental design, materials and methods

2.1. Plant collection and extraction

Flower heads of *Tagetes patula* were procured from plant nurseries in kadiyam, West Godavari district, Andhra Pradesh. Crude material was identified and authenticated by a botanist (Voucher specimen no., TPK-4) from Government Degree College Kukatpally, Hyderabad. The flower heads were dried under shade; coarsely powdered and crude powdered material was used for the extraction process.

2.2. Chemicals and reagents

Triton X-100 used was a product of SRL Chemicals, Sisco Research Laboratories PVT LTD. Maharashtra, India. Simvastatin drug used was a product of Sun Pharmaceuticals India LTD., Mumbai, India. Biochemical kits and all other chemicals were of analytical grade.

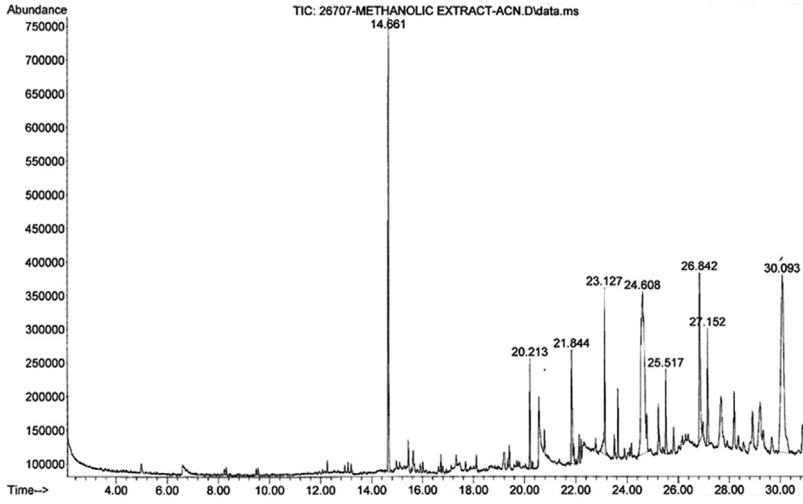
2.3. Preparation of extract

2.3.1. Plant extract

The powdered crude material of *Tagetes patula* was extracted with methanol by Soxhletion and crude extract obtained was evaporated to a solid mass, and preserved in desiccators to remove remaining moisture, if present.

2.3.2. Isolation of piperine

Piper nigrum (Black pepper) powder is used for extraction of piperine as per standard methods [1,2].



Signal : TIC: 26707-METHANOLIC EXTRACT-ACN.D\data.ms

peak #	R.T. min	first scan	max scan	last scan	PK TY	peak height	corr. area	corr. % max.	% of total
1	14.661	1859	1885	1906	BB	653800	10692366	42.49%	8.409%
2	15.441	1987	2001	2015	BV 7	44723	1015963	4.04%	0.799%
3	15.629	2024	2030	2049	VV 5	31386	1030535	4.10%	0.810%
4	16.722	2155	2193	2199	BV 7	26759	670649	2.67%	0.527%
5	17.322	2219	2283	2291	BV 7	17502	635400	2.53%	0.500%
6	19.409	2591	2596	2611	VV 4	34414	735093	2.92%	0.578%
7	20.213	2699	2716	2724	BV	159652	2607809	10.36%	2.051%
8	20.564	2740	2769	2795	BV 5	96436	4858765	19.31%	3.821%
9	20.777	2795	2801	2826	VB 2	46870	1583221	6.29%	1.245%
10	21.844	2910	2961	2984	BV	164703	5145387	20.45%	4.046%
11	22.130	2984	3003	3011	PV 4	41977	969838	3.85%	0.763%
12	22.211	3011	3015	3020	PV 2	33326	548420	2.18%	0.431%
13	22.320	3020	3032	3061	VB 2	23000	2092979	8.32%	1.646%
14	23.127	3111	3153	3187	BB	240128	6330584	25.16%	4.978%
15	23.508	3196	3210	3221	BV 3	36727	882700	3.51%	0.694%
16	23.647	3221	3231	3252	VV	103088	1920432	7.63%	1.510%
17	24.608	3329	3375	3437	BB 3	242730	25164196	100.00%	19.790%
18	25.223	3438	3467	3487	BV 8	71322	2065605	8.21%	1.624%
19	25.517	3503	3511	3523	BB	120359	2232459	8.87%	1.756%
20	25.823	3537	3557	3567	BV 4	39021	1081556	4.30%	0.851%
21	26.842	3689	3709	3723	BV 2	248588	7838684	31.15%	6.164%
22	26.968	3723	3728	3748	VV 4	37478	1454031	5.78%	1.143%
23	27.152	3748	3756	3786	VB	170284	4045563	16.08%	3.181%
24	27.678	3787	3835	3861	BV	74932	4920646	19.55%	3.870%
25	28.194	3887	3912	3929	BV	84077	2339845	9.30%	1.840%
26	28.916	3989	4020	4042	BV 6	62357	3533582	14.04%	2.779%
27	29.215	4042	4065	4077	VV 6	74520	5172765	20.56%	4.068%
28	29.335	4077	4083	4107	VB 9	32745	1563249	6.21%	1.229%
29	30.093	4159	4196	4269	BB 3	264727	22614602	89.87%	17.784%
30	30.886	4304	4315	4325	PV 2	39915	1412276	5.61%	1.111%

Fig. 1. Gas chromatogram and mass spectrometry spectra of methyl extract of flower heads of *Tagetes patula* (METP).

Table 1
GC – MS conditions during analysis.

GC CONDITION	
Column Oven	35 °C initial, hold
Temperature	time 5 min
Injector	250°C
Column Flow	1.2 mL/min
Carrier Gas	Helium 99.9995% Purity
Injection volume	1 mL
MS CONDITION	
Ion source temp	230 °C
MS quard	150 °C
Ionization	El (-70ev)
Scan speed	2000

Table 2

Anti-hyperlipidemic activity for methanolic extract *Tagetes patula* flower heads on Propylthiouracil induced hyperlipidemic rats.

Treatment	Lipid Profile (mg/dL)				
	Total Cholesterol	Triglyceride	HDL	LDL	VLDL
Normal control	161.5 ± 1.36	98.83 ± 2.02	63.33 ± 1.62	80.73 ± 3.13	19.76 ± 0.40
Hyperlipidemic control	258.66 ± 0.9 ** a	228.83 ± 1.07** a	13.33 ± 0.8** a	199.56 ± 1.3** a	45.76 ± 0.2** a
METP(200 mg/kg)	185.83 ± 1.2 ** a A	129.83 ± 0.94 ** a A	21.33 ± 1.7** a B	138.53 ± 2.1 ** a A	25.96 ± 0.1 ** a A
METP(200 mg/kg)	176.83 ± 1.6 ** a A	114.33 ± 1.42 ** a A	32.16 ± 1.3** a A	121.8 ± 2.02** a A	22.36 ± 0.2** a A
+ piperine(20 mg/kg)					
METP(400 mg/kg)	165 ± 1.84** a A	101.83 ± 1.27 ** aA	41.66 ± 1.3** a A	102.96 ± 2.2** a A	20.36 ± 0.2** a A
METP(400 mg/kg)	151 ± 1.15** A	97.83 ± 0.79** A	54.33 ± 1.5**	70.6 ± 1.69 ^b A	19.56 ± 0.1 ^a A
+ piperine(20 mg/kg)					
Simvastatin (10 mg/kg)	155.66 ± 1.1 ^A	93.33 ± 1.33 ^A	57.50 ± 1.0 ^A	78.83 ± 0.83 ^A	18.66 ± 0.2 ^A

Values are expressed as Mean ± SEM, (n=6). Statistical analysis was performed by using ANOVA followed by Dunnett's test. Results were compared with control group (** = p < 0.01, p < 0.05), hyperlipidemic control (A = p < 0.01, B = p < 0.05) and standard (a = p < 0.01, b = p < 0.05).

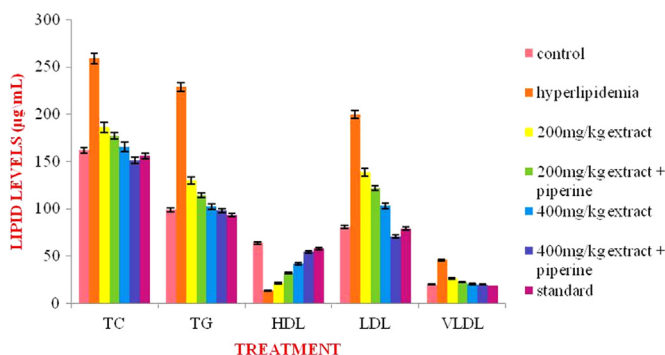
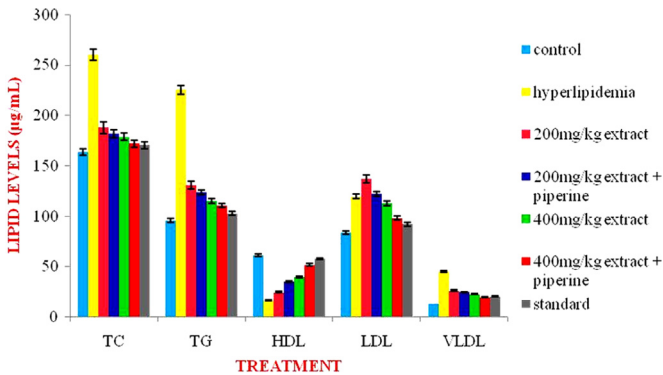
**Fig. 2.** Effect of METP on lipid levels of propylthiouracil induced hyperlipidemia.

Table 3Anti-hyperlipidemic activity for methanolic extract *Tagetes patula* flower heads on Triton induced hyperlipidemic rats.

Treatment	Lipid Profile (mg/dL)				
	Total Cholesterol	Triglyceride	HDL	LDL	VLDL
Normal control	163.83 ± 1.81	95.83 ± 1.83	61.16 ± 2.10	83.5 ± 1.91	19.16 ± 0.36
Hyperlipidemic control	260.16 ± 1.7 ^{** a}	225.33 ± 2.09 ^{** a}	15.66 ± 1.2 ^{** a}	199.43 ± 2.06 ^{** a}	45.06 ± 0.4 ^{** a}
METP (200 mg/kg)	187.66 ± 1.42 ^{** a A}	130.5 ± 1.96 ^{** a A}	24.66 ± 2.5 ^{** a B}	136.9 ± 1.69 ^{** a A}	26.1 ± 0.39 ^{** a A}
METP(200 mg/kg) + piperine(20 mg/kg)	181.66 ± 0.95 ^{** a A}	123.5 ± 1.58 ^{** a A}	35 ± 1.50 ^{** a A}	121.96 ± 1.01 ^{** a A}	24.7 ± 0.31 ^{** a A}
MEAB(400 mg/kg)	178.66 ± 1.8 ^{** a A}	115.33 ± 1.60 ^{** a A}	40 ± 1.73 ^{** a A}	112.53 ± 2.98 ^{** a A}	23.06 ± 0.3 ^{** a A}
METP(400 mg/kg) + piperine(20 mg/kg)	172.16 ± 1.6 ^{b B}	110.83 ± 1.77 ^{b A}	52 ± 1.34 ^{** b A}	98 ± 1.14 ^{** A b}	19.56 ± 0.1 ^A
Simvastatin (10 mg/kg)	170.5 ± 1.31 ^B	102.83 ± 1.83 ^A	57.83 ± 1.8 ^A	92.1 ± 1.05 ^A	20.56 ± 0.3 ^A

Values are expressed as Mean ± SEM, (n=6). Statistical analysis was performed by using ANOVA followed by Dunnett's test. Results were compared with control group (** = p < 0.01, = p < 0.05), hyperlipidemic control (A = p < 0.01, B = p < 0.05) and standard (a = p < 0.01, b = p < 0.05).

**Fig. 3.** Effect of METP on lipid levels of Triton X-100 induced hyperlipidemia.

2.4. Identification of phytochemical constituents using gas chromatography

GC–MS analysis was carried out by Agilent 6890 series GC–MS instrument coupled with mass spectroscopy as a detector. The temperature was adjusted to –30 °C to 280/300 °C. The HP-5MS column with dimensions 30 m × 0.32 mm × 0.25 µm was used for analysis. The oven temperature was adjusted to 35 °C and hold time 5 min, ramp 10 °C / min up to 220 °C. Column flow is 1.2 mL. The inlet temperature was kept at 250 °C and the source temperature of 230 °C and MS Quad temperature of 150 °C (Table 1).

2.5. *in vitro* antioxidant assays

The scavenging ability of free radicals as hydroxyl and NO was measured by the method of Kunchandy and Rao (1990) [3,4]. Data outcome is shown in Table 4.

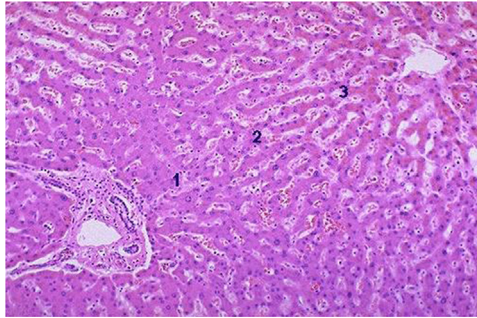


Fig. 4. Histopathology of rat's liver in control group, Bile duct appeared normal, no inflammation or fibrosis noticed surrounding the portal region of liver. Kupffer cells and sinusoids are normal. No evidence of fatty change and fibrosis.

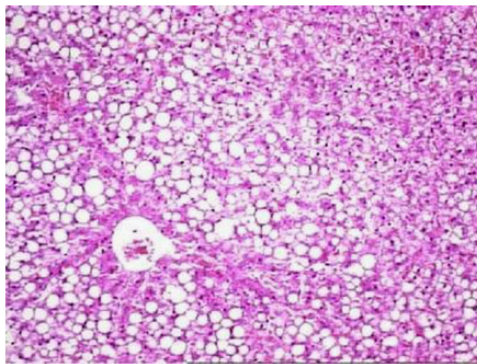


Fig. 5. Cord pattern of hepatocytes. Few periportal lymphocytes in focal area fibrosis noticed in periportal region of liver. Fatty change found in cytoplasm and fibrosis.

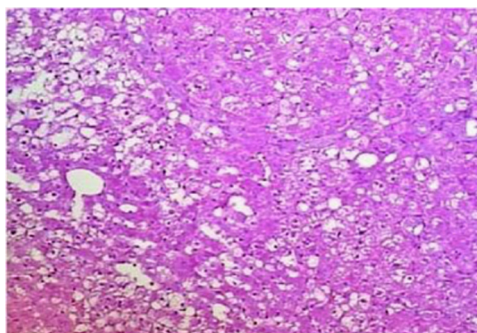


Fig. 6. Moderate sinusoidal space dilatation along with hemorrhages noticed in the sinusoidal space of liver. Few periportal lymphocytes in focal area.

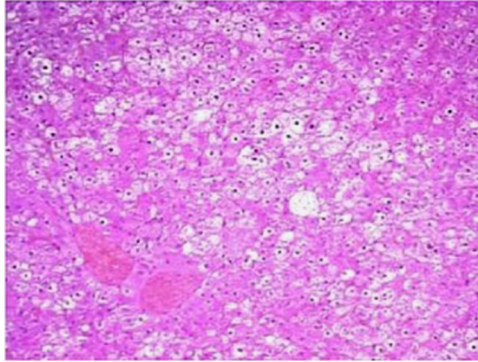


Fig. 7. Mild Cord pattern of hepatocytes. Mild sinusoidal space dilation along with hemorrhage. Kupffer cells are normal.

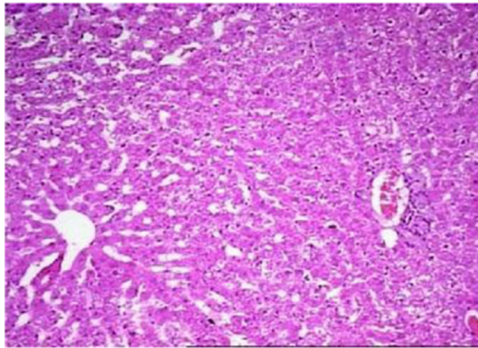


Fig. 8. Hepatocytes appeared normal, periportal and centrilobular region appeared normal but mild sinusoidal space dilation along with hemorrhage is noticed in sinusoidal spaces.

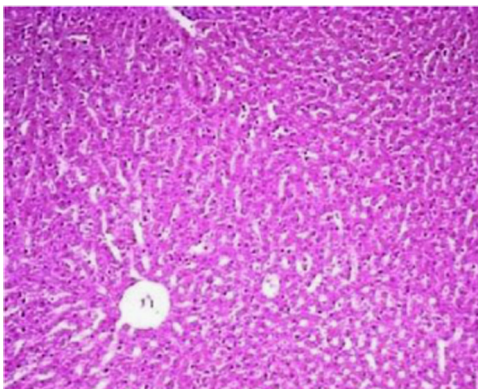


Fig. 9. Hepatocytes appeared normal, periportal and centrilobular region appeared normal but mild sinusoidal space dilatation noticed in the periportal region of liver.

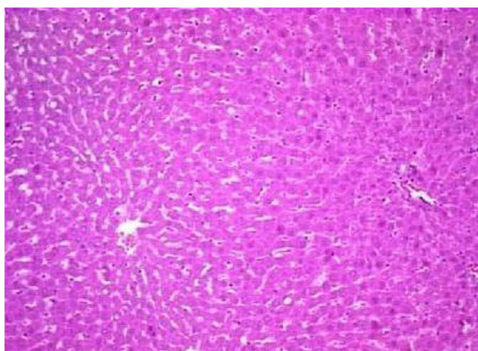


Fig. 10. Normal cord pattern of hepatocytes. Periportal few lymphocytes. Kupffer cells and sinusoids appeared to be normal. Periportal few lymphocytes. No evidence of fibrosis.

2.6. Animals

Wistar rats weighing about 170–200 g were procured from Gentox biosciences, Hyderabad for present experimental study. The data protocol was approved by the IAEC (Institutional Animal Ethical Committee Reg. No.1175/PO/ERe/S/08/CPCSEA) of CPCSEA (Committee for control and supervision of experimentation on animals).

2.7. Acute toxicity studies

An acute toxicity study up and down procedure (OECD guideline-425) was carried out for methanolic extract of *Tagetes patula* on female Wistar rats [5].

2.8. *in vivo* antihyperlipidemic activity of an extract of *Tagetes patula*

2.8.1. Propylthiouracil induced hyperlipidemia

Animals were given with propylthiouracil of 10 mg kg⁻¹ *p.o* b. wt. and 0.01% PTU in for 7 days to induce hyperlipidaemia and on 8th day animals are given with test drug orally [6].

The rats were completely randomized into seven groups of six rats each.

Group I: Control (received normal saline).

Group II: Hyperlipidemic rats PTU (10 mg/kg b. wt) 1–8 days + cholesterol (400 mg/kg b. wt) on 8th day.

Group III: PTU (10 mg/kg b. wt) 1–8 days + cholesterol (400 mg/kg b. wt) on 8th day + METP (200 mg/kg b. wt) on 8th day.

Group IV: PTU (10 mg/kg b. wt) 1–8 days + cholesterol (400 mg/kg b. wt) on 8th day + METP (200 mg/kg b. wt) + Piperine (20 mg/kg b. wt) on 8th day.

Group V: PTU (10 mg/kg b. wt) 1–8 days + cholesterol (400 mg/kg b. wt) on 8th day + METP (400 mg/kg b. wt) on 8th day.

Group VI: PTU (10 mg/kg b. wt) 1–8 days + cholesterol (400 mg/kg b. wt) on 8th day + METP (200 mg/kg b. wt) on 8th day + Piperine (20 mg/kg b. wt) on 8th day.

Group VII: Hyperlipidemic rats PTU (10 mg/kg b. wt) 1–8 days + cholesterol (400 mg/kg b. wt) on 8th day + Simvastatin (10 mg/kg b. wt) on 8th day.

Lipid levels were measured on 8th day using a Cholesterol measurement kit, the data analyzed is presented in Table 2.

Table 4
Antioxidant assay of methanolic flower extract of *Tagetes patula*.

S.no.	Test compounds	Antioxidant assay	IC ₅₀ value (µg/mL)
1	Ascorbic assay (standard)	Hydroxyl radical scavenging assay and Nitric oxide radical scavenging assay	24
2	METP	Hydroxyl radical scavenging assay Nitric oxide radical scavenging Assay	38 45

2.8.2. Triton induced hyperlipidemic rat model [7]

The rats were completely randomized into seven groups of six rats each.

Group I: Control (received normal saline).

Group II: Triton X-100 (100 mg/kg b. wt *i.p*)

Group III: Triton X-100 (100 mg/kg b. wt *i.p*) + METP (200 mg/kg b. wt).

Group IV: Triton X-100 (100 mg/kg b. wt *i.p*) + METP (200 mg/kg b.wt) + Piperine (20 mg/kg b. wt).

Group V: Triton X-100 (100 mg/kg b. wt *i.p*) + METP (400 mg/kg b. wt).

Group VI: Triton X-100 (100 mg/kg b. wt *i.p*) + METP (400 mg/kg b. wt) + Piperine (20 mg/kg b. wt).

Group VII: Triton X-100 (100 mg/kg b. wt *i.p*) + Simvastatin (10 mg/kg b. wt).

Lipid levels measured using a Cholesterol measurement kit, the data analyzed is presented in Table 3.

2.9. Histopathology of the liver of propylthiouracil induced diabetic rats

On 8th days of study, the animals were sacrificed to separate livers, which were fixed in 10% formalin for 24 h and used for histopathological studies. The data of histopathological studies were shown in Figs. 4–10.

2.10. Statistical analysis

The results were expressed as mean \pm SEM. The results were subjected to statistical analysis by using one way ANOVA followed by Dunnett's test $p < 0.05$, $p < 0.01$ was considered as statistically significant.

Acknowledgments

The authors wish to thank to Management, GRES and Principal Dr. C V S Subrahmanyam, Gokaraju Rangaraju College of Pharmacy, Bachupally, Hyderabad and Osmania University, Hyderabad for providing technical support, facility for the study.

Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at <https://doi.org/10.1016/j.dib.2018.10.022>.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.dib.2018.10.022>.

References

- [1] N. Kanaki, M. Dave, H. Padh, M. Rajani M, A rapid method for isolation of piperine from the fruits of *Piper nigrum* Linn, *J. Nat. Med.* 62 (3) (2008) 281–283.
- [2] R. Smita, B. Priyanka, P. Urmi, Extraction and evaluation of piperine from *Piper nigrum* Linn, *Int. J. Appl. Biol. Pharm. Technol.* 2 (2) (2011) 144–149.
- [3] E. Kunchandy, M.N.A. Rao, Oxygen radical scavenging activity of curcumin, *Int. J. Pharm.* 58 (1990) 237–240.
- [4] OECD, Guidance document on acute oral toxicity, *Environ. Health Saf. Monogr. Ser. Test. Assess.* 24 (2000).
- [5] M. Alam, N. Bristi, M. Rafiqzaman, Review on in vivo and in vitro methods evaluation of antioxidant activity, *Saudi Pharm. J.* 21 (2) (2013) 143–152.
- [6] P. Hasimun, E. Sukandar, I. Adnyana, D. Tjahjono, A simple method for screening antihyperlipidemic agents, *Int. J. Pharmacol.* 7 (1) (2011) 74–78.
- [7] N. Adigun, A. Oladiji, T. Ajiboye, Antioxidant and anti-hyperlipidemic activity of hydroethanolic seed extract of *Aframomum melegueta* K. Schum in Triton X-100 induced hyperlipidemic rats, *South Afr. J. Bot.* 105 (2016) 324–332.