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Research Article

Anti-obesity Activity of Extract of *Curculigo orchioides Gaertn*. Root in High Fat Diet-induced Obesity in Rats

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ABSTRACT

Curculigo orchioides known as Musali or Talamuli in Ayurveda. Rhizome of *C. orchioides* is one of a reputed drugs mentioned in the ancient books of Ayurveda and Siddha, Unani and used as an analgesic, anti-inflammatory, spermatogenic, aphrodisiac, immunostimulant, hepatoprotective, anti-asthmatic etc. To investigate the anti-obesity activity of extract of *C. orchioides* root in high fat diet-induced obesity rats. The five groups in this study were, group I (normal), group II received high fat diet, group III received obese rats given orlistat (50 mg/kg, p.o.), groups IV-Obese rats given extract of *C. orchioides* root 500 mg/kg, p.o. and groups V-Obese rats given extract of *C. orchioides* 1000 mg/kg, p.o. On 30th day of experiment, blood glucoses level, lipid profile and biochemical parameter were performed. Body weight of animals was significantly ($p < 0.05$) maintained in all treatment groups. Progressive maintained blood glucose, lipid profile, and oxidative stress biomarkers were found in all treatment groups during study. The obtained results clearly suggested that *C. orchioides* possess pronounced anti-obesity potential

Introduction

The most important and the authentic works in Indian medicinal plants is found in the classics of Ayurveda i.e. *Charak Samhita*, *Susruta Samhita* and *Astangahridaya* which are believed to have been written in the Pre-Buddhist period, i.e., before 600 B.C. These works incorporate 700-800 drugs of medicinal value used in several preparations for the treatment of various diseases. They also serve as the basis for the medicinal plant research as well as in other countries.[1] According to World Health Organization as much as 80% of population in developing countries is dependent on plants for primary health care. Statistical data reveal that as many as 3226 out of 4752 communities in India are dependent on traditional medicine derived from plants. A status report on ethnobiology in India, undertaken by Ministry of Environment and Forests has indicated that the tribal communities use over 7500 species of plant for medicinal purpose.[2] For investigation of natural products, two methods are selected; first is laboratory based called classical method relies on previous taxonomic findings, random screening methods and phyto-chemical factors. Second method, which is now becoming more popular in all researchers, in search of conventional texts and herbal medicine use, including oral interviews with traditional indigenous healers – the ethnobotanical route.[3]

For very long time, the only way to use plant medicines was either direct application or alternatively crude extracts; used for medicinal observations. Fractions and extractions methodology improves significantly along with development of organic chemistry at the starting of this century. With this, identification and isolation of

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active chemicals became possible from plants. During 1940s, advancement in chemical synthesis discovered the synthesis of plants components and derivatives. It was further thought that drug chemical synthesis will be more efficient and cost effective than isolation from naturally available resources. A large number of small molecules, like phenolics, polyphenols, terpenes (e.g.,mono-, di-, tri-), flavonoids, sugar-containing compounds, were found to be promising drugs. Many plant-derived compounds have been used as drugs, either in their original or semi-synthetic form. Plant secondary metabolites can also serve as drug precursors, drug prototypes, and pharmacological probes. Truly, this has resulted favourable most cases. Furthermore, in various other cases, natural resources are cost effective than synthetic. Motivated by these achievements, together with the truth that complex structure of many drugs may be entirely totally impossible to synthesize, now there is a resurgent trend of coming back to natural resources for drug development.[4] These facts coupled with present industrial factors and socioeconomic, convinced human to return back to nature. Current analysis in USA at community pharmacy shows that 205 prescriptions contain substance derived from higher plants.[5]

According to the WHO, medicinal plants are the best source to obtain a variety of drugs.[6] Contrary to the synthetic drugs, antimicrobial drugs of plant origin do not have any side effects and it also have an enormous therapeutic potential to heal many infectious diseases.[7] Therefore, there is an opportunity to observe the antioxidant and antibacterial effect of *C. orchioides*. *C. orchioides* has been evaluated for anti-asthmatic activity. Asthma is a very commonly occurring condition that is most difficult to control in chronic stage. Histamine is one of the major inflammatory mediators in the immediate phase of asthma, causing airway hyper responsiveness and bronchial airway inflammation. *C. orchioides Garten*. is one of the important plant mentioned in Ayurveda and Unani for asthma.[8] Triterpenoids (Curculigol), glycosides (Curculignin A, B, C) curculigosaponin such as curculigenin A, B, C, corchicoside A, curculigoside B and alkaloids (Yuccagenin, Lycorin) are major components reported which might be responsible for various medicinal use of herb. *C. orchioides* has been reported to possess anti-inflammatory activity. To investigate the anti-obesity activity of extract of *C. orchioides* root in high fat diet-induced obesity rats.

Materials and Methods

Animals

Wistar rats (150-180 g) were group housed (n = 6) under a standard 12 hours light/dark cycle and controlled conditions of temperature and humidity (25 ± 2°C, 55–65%). Rats received standard rodent chow and water *ad libitum*. Rats were acclimatized to laboratory conditions for 7 days before carrying out the experiments. All the experiments were carried in a noise-free room between 08.00 to 15.00 h. Separate group (n = 6) of rats was used for each set of experiments. The animal studies were approved by the Institutional Animal Ethics Committee (Reg. No. 1582/PO/Re/S/11/CPCSEA). The guidelines of CPCSEA, India were strictly followed during the maintenance and experiment.

Induction of Obesity

After 7 days of acclimatization, animals were randomly divided into five groups (n = 6): one normal control group, one HFD control and remaining III–V as treatment groups. Animals in normal control group were fed with normal diet while the other groups were fed with high-fat diet (HFD)[9] *ad libitum*, throughout the experiment.

Experimental Design and Treatment Protocol-High Fat Diet-induced Obesity

The animals were divided into six groups of six animals each as follows:

- *Group I:* Normal rats fed with normal diet throughout the study
- *Group II:* Obese control rats fed with HFD for 30 days
- *Group III:* Obese rats given orlistat suspension prepared with saline 50mg/kg, p.o. for 30 days
- *Group IV:* Obese rats given an extract of *C. orchioides* 500 mg/kg, p.o. for 30 days
- *Group V:* Obese rats given an extract of *C. orchioides* 1000 mg/kg, p.o. for 30 days

Anti-obesity Screening

Determination of Body Weight

During the experimental period, the change in body weight of each rat was measured.

Biochemical Evaluation in Serum

Serum total cholesterol level (TC), triglyceride (TG) level, high-density lipoproteins (HDL), total protein (TP), alanine aminotransferase (ALT), aspartate aminotransferase (AST) was determined by using a standard available marketed kit. The estimation procedure is obtained in detail from leaflets provided by the commercially available kits are as follows.

The biochemical indicator assessment was done from the each group with 10% w/v homogenate liver for determination of lipid peroxidation-malondialdehyde (MDA), reduce glutathione (GSH) level, superoxide dismutase (SOD) and catalase activity (CAT).

Statistical Analysis

All statistical analysis is expressed as the mean ± standard error of the mean (SEM). Data were analyzed by one way ANOVA, where applicable $p < 0.05$ was considered statistically significant, compared with vehicle followed by Dunnett's test.

RESULTS

Determination of Body Weight

Fig. 1 presents the body weights of animals (in all groups) at the start and end of the study. Body weight of animals was significantly ($p < 0.05$) maintained in all treatment groups Orlistat (50 mg/kg p.o.), Extract of *C. orchioides* root (500 mg/kg/p.o and 1000 mg/kg/p.o.) (171.5 ± 11.40; 191.20 ± 6.30 and 178.20 ± 6.20) during the study as compared to control group (268.5 ± 10.01).

Blood Sampling and Glucose Estimation

As shown in Fig. 2, the Blood glucose level of animals in all groups was recorded at 0, 8th, and 21st day. A progressive decrease in blood glucose level was found in all treatment groups during the study. At the end of experiment Orlistat 50 mg/kg p.o., Extract of *C. orchioides* (500 mg/kg/p.o and 1000 mg/kg/p.o) (120.10 ± 5.13; 148.10 ± 6.40 and 127.30 ± 5.50) treated group blood glucose level was decreased significantly ($p < 0.05$) at 21st days, respectively

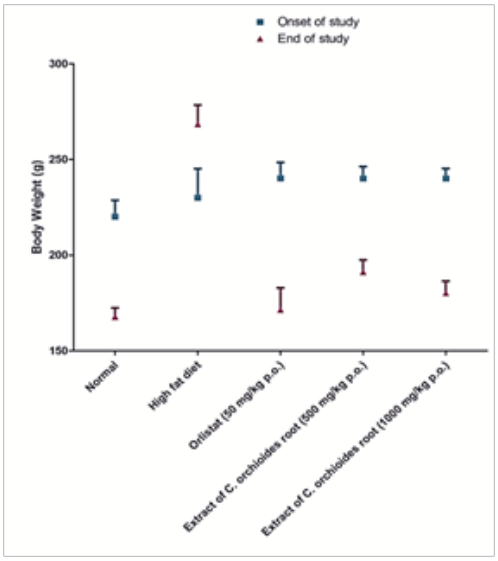

Fig. 1: Mean Body Weight Change

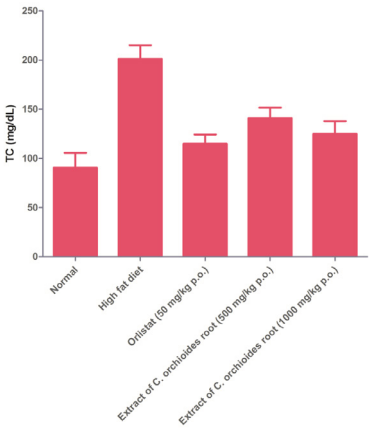

Fig. 3: Effect of Extract of *C. orchioides* root on total cholesterol level in HFD-induced obesity rats

Estimation of Lipid Profile

Extract of *C. orchioides* root 500 mg/kg/p.o and Extract of *C. orchioides* root 1000 mg/kg/p.o (141.10 ± 4.10; 125.10 ± 5.00) treated group total cholesterol also decreased significantly ($p < 0.05$). In 50 mg/kg Orlistat (115.01 ± 3.60) treated group total cholesterol decreased significantly ($p < 0.05$), respectively as compared with control group (201.20 ± 5.40), as shown in Fig. 3.

Extract of *C. orchioides* root (500 mg/kg/p.o. and 1000 mg/kg/p.o.) (104.00 ± 8.10; 95.00 ± 9.20) treated group triglyceride also decreased significantly ($p < 0.05$). In 50 mg/kg Orlistat (88.00 ± 9.13) treated group triglyceride decreased significantly ($p < 0.05$), respectively as compared with control group (144.5 ± 6.60), as shown in Fig. 4.

As shown in Fig. 5, in Extract of *C. orchioides* root 500 mg/kg/p.o and Extract of *C. orchioides* root 1000 mg/kg/p.o (92.40 ± 2.60; 63.00 ± 2.30) treated group LDL also decreased significantly ($p < 0.01$). In 50 mg/kg p.o. Orlistat (54.40 ± 2.51) and treated group LDL was significantly decreased ($p < 0.001$), respectively as compared with the control group (170.10 ± 2.50).

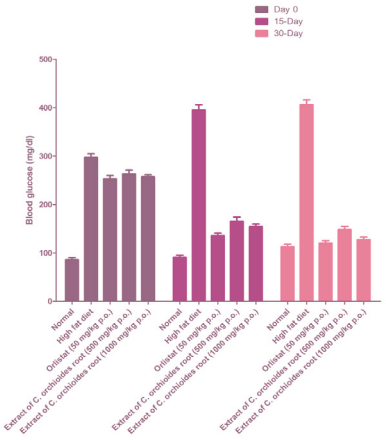

Fig. 2: Anti-obesity activity of Extract of *C. orchioides* root on blood glucose level in HFD induced obesity rats

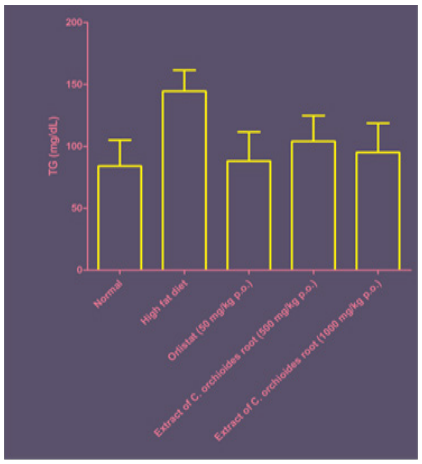

Fig. 4: Effect of Extract of *C. orchioides* root on triglyceride level in HFD-induced obesity rats

As shown in Fig. 6, in Extract of *C. orchioides* root (500 mg/kg/p.o and 1000 mg/kg/p.o.) (42.20 ± 1.60; 53.75 ± 2.25) treated group HDL also increased significantly ($p < 0.001$). In 5 mg/kg p.o. Orlistat (57.75 ± 2.17) treated group HDL increased significantly ($p < 0.001$), respectively as compared with control group (33.55 ± 2.87).

Estimation of Total Protein (TP)

As shown in Fig. 7, in Extract of *C. orchioides* root (500 mg/kg/p.o and 1000 mg/kg/p.o) (7.0 ± 0.60; 7.8 ± 0.70) treated group total protein also increased significantly ($p < 0.001$). In 50 mg/kg p.o. Orlistat (8.5 ± 0.60) treated group total protein increased significantly ($p < 0.001$), respectively as compared with control group (5.8 ± 0.50).

Serum Biomarkers

After 15 days of the experiment, serum transaminase such as ALT, AST, and ALP levels was significantly ($p < 0.001$) elevated in the obesity control group. A dose of 500 mg/kg and 1000 mg/kg of ethanolic Extract of *C. orchioides* root (84.20 ± 4.30; 71.60 ± 4.30), and 50 mg/kg Orlistat (64.20 ± 4.10) treatment groups SGPT level was decreased significantly ($p < 0.05$) as compared to control group, respectively as shown in Fig. 8.

As shown in Fig. 9, doses of 500 mg/kg and 1000 mg/kg of ethanolic extract of *C. orchioides* root (85.78 ± 3.40; 63.20 ± 3.40) and 50 mg/kg Orlistat (59.55 ± 3.10) treatment groups SGOT level was decreased significantly ($p < 0.05$) as compared to control group, respectively.

Estimation of SALP

A dose of 500 mg/kg of ethanolic extract of *C. orchioides* root (194.55 ± 5.20) and 1000 mg/kg of ethanolic extract of *C. orchioides* root (164.20 ± 5.40) and 50 mg/kg Orlistat (149.75 ± 5.20) treatment groups SALP level was decreased

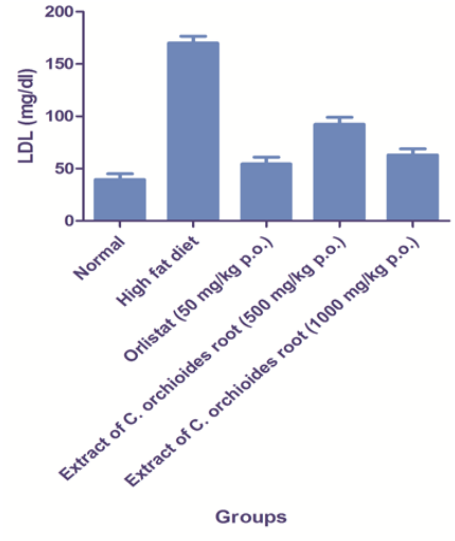

Fig. 5: Effect of Extract of *C. orchioides* root on LDL in HFD-induced obesity rats

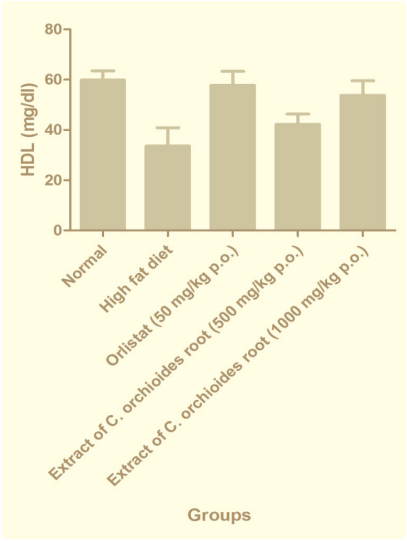

Fig. 6: Effect of Extract of *C. orchioides* root on HDL in HFD-induced obesity rats

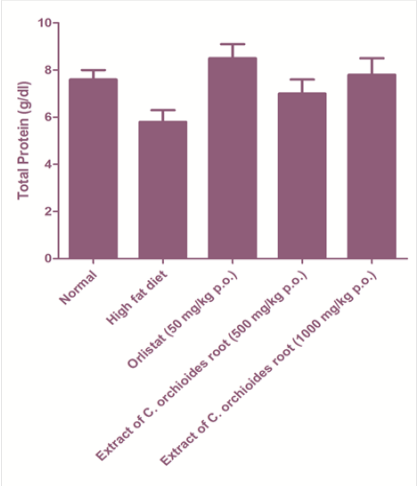

Fig. 7: Effect of ethanolic Extract of *C. orchioides* root on serum lipid profiles i.e., total protein level in rats

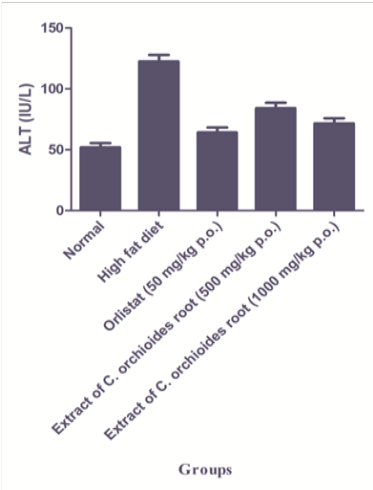

Fig. 8: Effect of ethanolic extract of *C. orchioides* root on ALT in HFD-induced obesity rats

significantly ($p < 0.05$) as compared to control group, respectively, as represented in Fig. 10.

Estimation of Super Oxide Dismutase

From the antioxidant study, it was found that in HFD induced obesity control group, Super Oxide dismutase (SOD) level was decreased significantly ($p < 0.001$), while in the treated group, ethanolic Extract of *C. orchioides* roots 500 mg/kg/p.o and Extract of *C. orchioides* root 1000 mg/kg/p.o group. SOD level increased significantly ($p < 0.001$), as represented in Fig. 11.

Estimation of Lipid Peroxidation

In HFD-induced obesity controlled group, lipid peroxidation was found to be increased significantly ($p < 0.001$), while in ethanolic extract of *C. orchioides* root 500 mg/kg/p.o

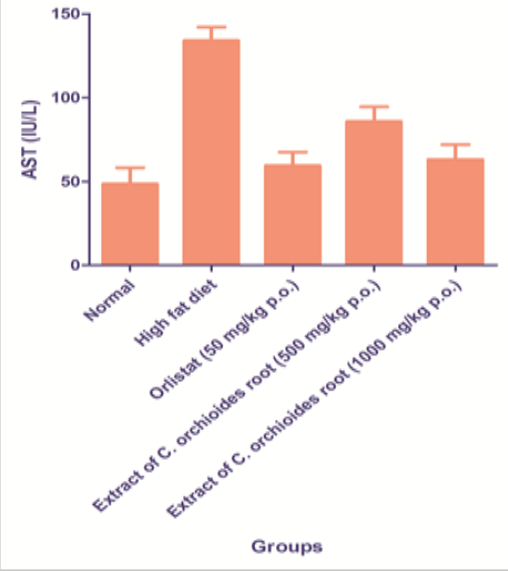

Fig. 9: Effect of ethanolic extract of *C. orchioides* root on AST in HFD-induced obesity rats

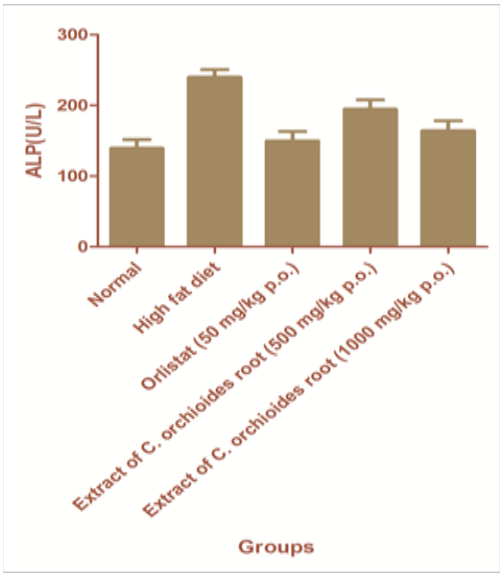

Fig. 10: Effect of ethanolic extract of *C. orchioides Gaertn*. on serum biomarkers i.e., SALP in rats

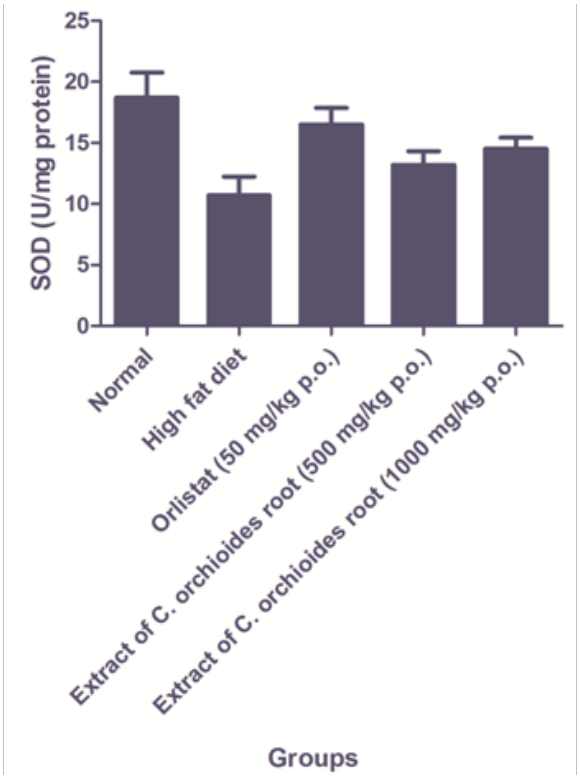

Fig. 11: Effect of ethanolic extract of *C. orchioides* root complexes on SOD level in rats

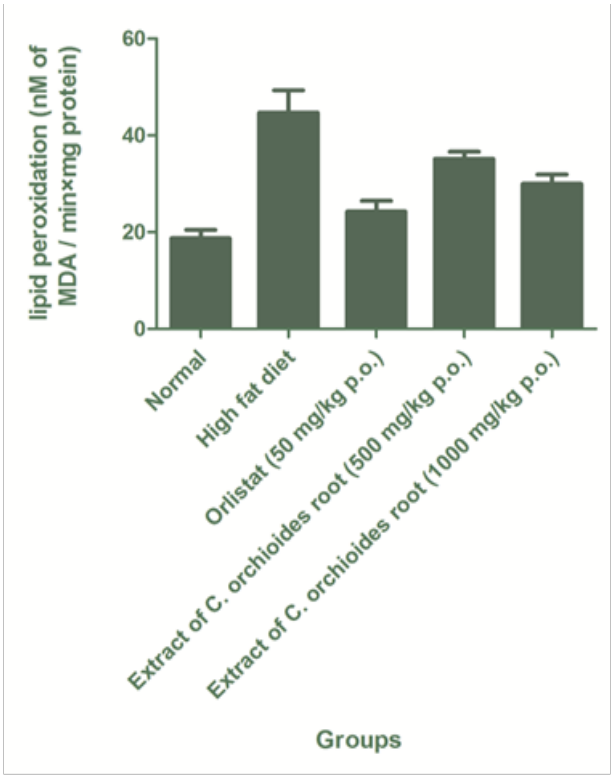

Fig. 12: Effect of ethanolic Extract of *C. orchioides* root complexes on lipid peroxidation level in rats

and extract of *C. orchioides* root 1000 mg/kg/p.o group treated group, there was a significant decrease found in lipid peroxidation ($p < 0.05$) (Fig. 12).

Estimation of Catalase Activity

In HFD induced obesity control group catalase (CAT) was found to be decreased significantly ($p < 0.001$), while in ethanolic Extract of *C. orchioides* root 500 mg/kg/p.o and Extract of *C. orchioides* root 1000 mg/kg/p.o treated group, and there was a significant increase in CAT ($p < 0.05$) (Fig. 13).

Estimation of reduced GSH

In HFD induced obesity control group, reduced glutathione (GSH) was found to be decreased significantly ($p < 0.001$), while in ethanolic Extract of *C. orchioides* root 500 mg/kg/p.o and Extract of *C. orchioides* root 1000 mg/kg/p.o group, there was a significant increase found in GSH ($p < 0.05$) (Fig. 14).

Discussion

The present study assessed the effects of *C. orchioides* root on obesity using a high-fat diet-induced rat model. Obesity occurs when food consumption, basal metabolism, and energy usage are all out of control. Obesity may be caused by a variety of endogenous or environmental factors at the personal level. Obesity is believed to be caused by a combination of excessive caloric intake and the availability of energy-dense foods in the majority of cases.[10] Obesity is linked with a general dysregulation of metabolic homeostasis, leading to insulin resistance, dyslipidemia, impaired blood pressure, and an elevated risk for diabetes, cardiovascular disease and cancer. As a result, obesity and its comorbidities are hot topics in fundamental science and clinical research.[11] In different strains of rats, high-fat foods have been shown to cause increased body weight and diabetes.[12] Wistar rats treated with *C. orchioides* had significantly lower food intake and body weight at 500 mg/kg and 1000 mg/kg. The active principles in *C. orchioides* have been related to several therapeutic effects, including hypolipidemia, thermogenesis, and carminative effects.[13] An increase in liver weight indicates hypertrophy or hyperplasia of the liver.[14] The liver is a rapidly metabolizing organ that is vulnerable to fat deposition, and the current study found that excessive fat administration resulted in significantly increased liver weight.[15] This high-fat diet intake effect could be attributed to improved body weight that causes lethargy and reduced motility. In wistar rats, high-fat diet administration for 30 days reduced ambulation and rearing while increasing grooming, as shown by an open field test. The administration of *C. orchioides* at both dose levels resulted in a high-fat diet decreased blood glucose levels and some lipid parameters such as TG, TC, LDL, and VLDL

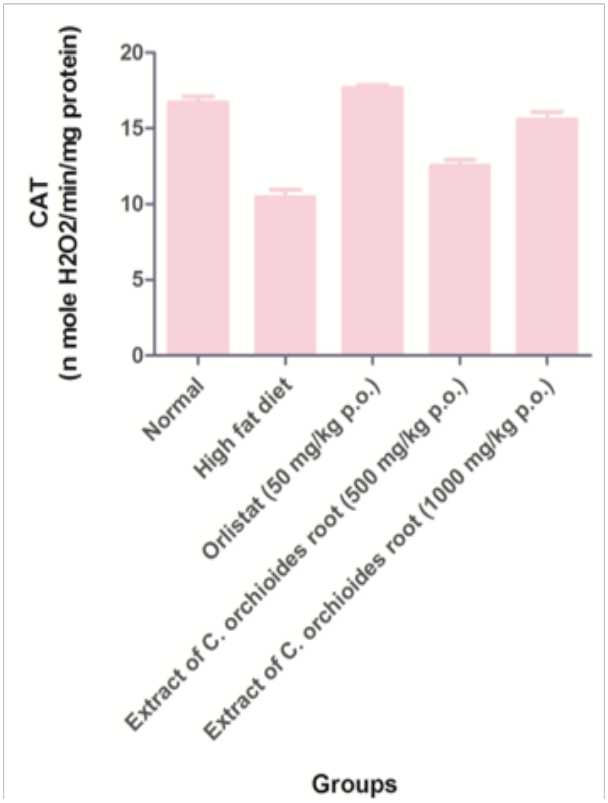

Fig.13: Effect of Extract of *C. orchioides* root complexes on CAT level in rats

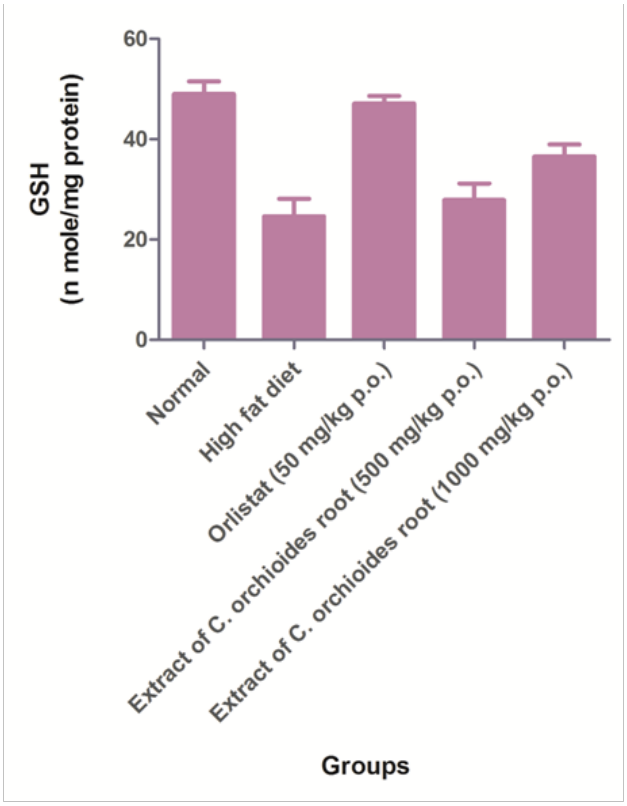

Fig. 14: Effect of ethanolic Extract of *C. orchioides* root complexes on GSH level in rats

while increased HDL levels.[16] Both doses of *C. orchioides* oral administration resulted in a substantial rise in HDL levels. Compared to the high-fat diet induced-untreated population, 30 days of treatment with *C. orchioides* (500 mg/kg and 1000 mg/kg) substantially decreased ALT and AST levels.[17] Furthermore, *C. orchioides* (500 mg/kg and 1000 mg/kg) decreases MDA, whereas more significantly increases SOD, CAT, and GSH levels in serum ($p < 0.01$).[18] Finally, after 30 days of oral administration of a *C. orchioides* restored body weight, exploratory behavior, and biochemical and histopathological changes caused by the constituents. Finally, after 30 days of oral administration of *C. orchioides* restored body weight and biochemical changes caused by the constituents. At a dosage of 1000 mg/kg, the maximum activity was observed. As a result of its possible anti-obesity effect, it can be considered an important therapy in managing obesity.

The study suggests that the extract of *C. orchioides* significantly maintained the body weight and oxidative stress biomarkers. The obtained results suggested that *C. orchioides* possess pronounced anti-obesity potential.

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