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EFFECTS OF AQUEOUS EXTRACTS OF *EMILIA SONCHIFOLIA* AND *BRIDELIA FERRUGINEA* LEAVES, AND *RHIZOPHORA RACEMOSA* STEM BARK ON LIPID PROFILE OF WISTAR RATS EXPOSED TO PETROL FUMES

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ABSTRACT

Background: Prolonged inhalation of petrol fumes is a significant occupational and environmental health hazard, associated with oxidative stress and dyslipidemia, which increase cardiovascular risk. The aim of this work was to evaluate the protective capacity of aqueous extracts derived from *Emilia sonchifolia* leaves, *Bridelia ferruginea* leaves and *Rhizophora racemosa* stem bark against alterations in the lipid profile of Wistar rats exposed to petrol fume exposure. **Methods:** The fifty-four male Wistar rats were randomly allocated to nine experimental groups (6 per group). A normal control group received distilled water. The remaining groups were exposed to petrol fumes (4 hours daily for 28 days) and treated orally with either distilled water (positive control), Vitamin E (200 mg/kg, standard antioxidant), or one of the plant extracts at 200 mg/kg or 400 mg/kg doses. Blood was collected periodically for analysis of serum total cholesterol, triglycerides, HDL and LDL levels. **Results:** Exposure to petrol fumes induced significant dyslipidemic condition, marked by increased in total cholesterol, triglyceride and LDL levels, coupled with a decrease in high-density lipoprotein (HDL) levels, alongside a reduction in HDL. Treatment with all three plant extracts, particularly at the 400 mg/kg dose, significantly reversed these alterations in a dose-dependent manner. The restorative effects of the extracts were comparable to, and in some cases superior to, those of Vitamin E, effectively normalizing the lipid profile parameters towards levels observed in the unexposed control group. **Conclusion:** The aqueous extracts of *Emilia sonchifolia*, *Bridelia ferruginea*, and *Rhizophora racemosa* demonstrated potent protective effects against petrol fume-induced dyslipidemia. This activity is likely mediated by their rich phytochemical constituents, which mitigate oxidative stress and restore lipid homeostasis. These findings suggest that these plants are promising candidates for developing natural therapies to counteract the adverse metabolic effects of hydrocarbon exposure.

INTRODUCTION

Petroleum products remain indispensable to modern societies, serving as the primary fuel source for transportation, electricity generation, and various industrial applications. Petrol, also referred to as Premium Motor Spirit (PMS), is one of the most widely used derivatives of crude oil. However, its extensive use is associated with environmental and occupational health risks due to the release of volatile hydrocarbons during combustion and evaporation (Rahimi Moghadam *et al.*, 2020). Inhalation of petrol fumes, a common occurrence among individuals living near fuel stations, automobile workshops, and industrial sites, has been linked to oxidative stress, disruption of lipid metabolism, and damage to vital organs, particularly the liver, kidney, and cardiovascular system (Uboh *et al.*, 2007; Ezomoh, *et al.*,

2023). It has been established that prolonged exposure to petroleum vapors alters lipid homeostasis, elevates circulating cholesterol and triglyceride levels and an increased risk of developing metabolic and cardiovascular disorders (Abubakar *et al.*, 2015).

The evaluation of lipid profile, comprising the quantification of triglycerides, low-density lipoprotein cholesterol (LDL-C), total cholesterol and high-density lipoprotein cholesterol (HDL-C), serves as an essential biomarker for assessing cardiovascular risk and systemic metabolic Oxidative stress and free radical generation induced by petrol fumes can disrupt lipid regulation, thereby predisposing exposed individuals to dyslipidemia, atherosclerosis, and related cardiovascular complications (Wang, *et al.,* 2025). Hence, mitigating these adverse effects is of significant biomedical interest.

For centuries, medicinal plants have been valued for their capacity to treat oxidative stress and metabolic disorders, owing to their abundance of phytochemicals compounds that exhibit antioxidant, anti-inflammatory and lipid-lowering effects (Agbor *et al.,* 2022). *Emilia sonchifolia* (Asteraceae), commonly known as lilac tassel flower, is traditionally employed in the treatment of inflammation, wounds, hypertension, and gastric ulcers. It is phytochemically rich in flavonoids, alkaloids, tannins, and carotenoids, which contribute to its antioxidant and protective properties (Hussain *et al.,* 2023). Similarly, *Bridelia ferruginea* (Phyllanthaceae), widely used in African ethnomedicine, is reported to possess anti-inflammatory, antimicrobial, hypoglycemic, and ulcer-protective properties, with pharmacological studies confirming its bioactivity against oxidative damage and metabolic disturbances (Yeboah *et al.,* 2022). *Rhizophora racemosa* (Rhizophoraceae), a mangrove plant commonly found in West Africa, is valued for its use in traditional medicine against gastrointestinal disorders, infections, and inflammatory conditions, and is reported to contain polyphenols and tannins with strong antioxidant and cardioprotective potentials (Uebari, *et al.,* 2022).

Given the increasing health concerns associated with petrol fume exposure and the growing interest in natural plant-based therapies, investigating the potential of these medicinal plants in modulating lipid abnormalities induced by toxic exposures is imperative. This study, therefore, aims to evaluate the effects of aqueous extracts of *Bridelia ferruginea* and *Emilia sonchifolia* leaves and *Rhizophora racemosa* stem bark on the lipid profile of Wistar rats exposed to petrol fumes. The findings are expected to provide scientific insights into the protective roles of these plants in maintaining lipid homeostasis and reducing cardiovascular risks associated with hydrocarbon-induced oxidative stress.

MATERIALS AND METHODS

Plant Material Collection and Extract Preparation

Emilia sonchifolia and *Bridelia ferruginea* were collected in Amassoma town, located in Bayelsa State, Nigeria. The leaves were washed with cold water, air-dried in shade for two weeks and then pulverized using an electric blender. For extraction, 100 g of each powdered sample was macerated in 1 liter of distilled water for 72 hours with periodic agitation. After filtration using 110 mm Whatman filter paper, the filtrate was evaporated at 60°C using a water bath. The obtained aqueous extracts were stored in labeled containers at refrigerated temperatures until further use.

The stem bark of *Rhizophora racemosa* was collected from Edema, Ogbia Local Government Area, Bayelsa State. It underwent the same preparation process cleaning, shade-drying, grinding, and aqueous extraction for 72 hours. After filtration and evaporation, the extract was refrigerated for subsequent experiments.

Chemicals and Reagents

Petrol (Premium Motor Spirit, PMS) was procured from the Nigerian National Petroleum Corporation (NNPC) filling station in Edepie, Yenagoa, Bayelsa State. Randox™ Laboratories Ltd, UK, supplied the biochemical assay kits, while other analytical reagents were obtained from Loba Chemie PVT LTD, India.

Animal Subjects

A total of fifty-four healthy male Wistar rats weighing 200-250g were used for this study.

Ethical Considerations

All experimental procedures conducted in this study received formal ethical approval.

Study Design

The rats were randomly distribution into nine groups (6 per group) and treated orally for 28 days as follows:

1. **Normal control** – Received distilled water only.
2. **Positive control** – Exposed to petrol fumes + distilled water.
3. **Petrol fumes +** *E. sonchifolia* (200 mg/kg).
4. **Petrol fumes +** *E. sonchifolia* (400 mg/kg).
5. **Petrol fumes +** *B. ferruginea* (200 mg/kg).
6. **Petrol fumes +** *B. ferruginea* (400 mg/kg).
7. **Petrol fumes +** *R. racemosa* (200 mg/kg).
8. **Petrol fumes +** *R. racemosa* (400 mg/kg).
9. **Petrol fumes + Vitamin E** (200 mg/kg).

All treatments were administered via oral gavage.

Petrol Fume Exposure Procedure

In accordance with previously established methods (Owagboriaye *et al.,* 2016; Uboh *et al.,* 2005), rats were exposed to petrol vapors within a custom-built wooden inhalation chamber measuring 150 × 90 × 210 cm. To achieve vapor saturation, two open beakers, each containing 500 ml of petrol were placed in the chamber one hour before each session. The animals underwent

daily four-hour exposure periods for 28 days, after which they were returned to an uncontaminated environment.

Sample Collection and Biochemical Assessment

Blood samples were drawn from the submandibular vein on days 0, 1, 7, 14, 21, and 28 under mild chloroform anesthesia. Sampling was conducted 24 hours post-exposure.

Total cholesterol, triglycerides, HDL and LDL levels were measured according to the manufacturer's instructions provided in the biochemical assay kits.

Data Analysis

Values are shown as mean ± SEM. Statistical significance between groups was determined using one-way ANOVA and Tukey's post-hoc test for multiple comparisons (SPSS Version 20, IBM, USA). Differences were considered statistically significant when $p < 0.05$.

RESULTS

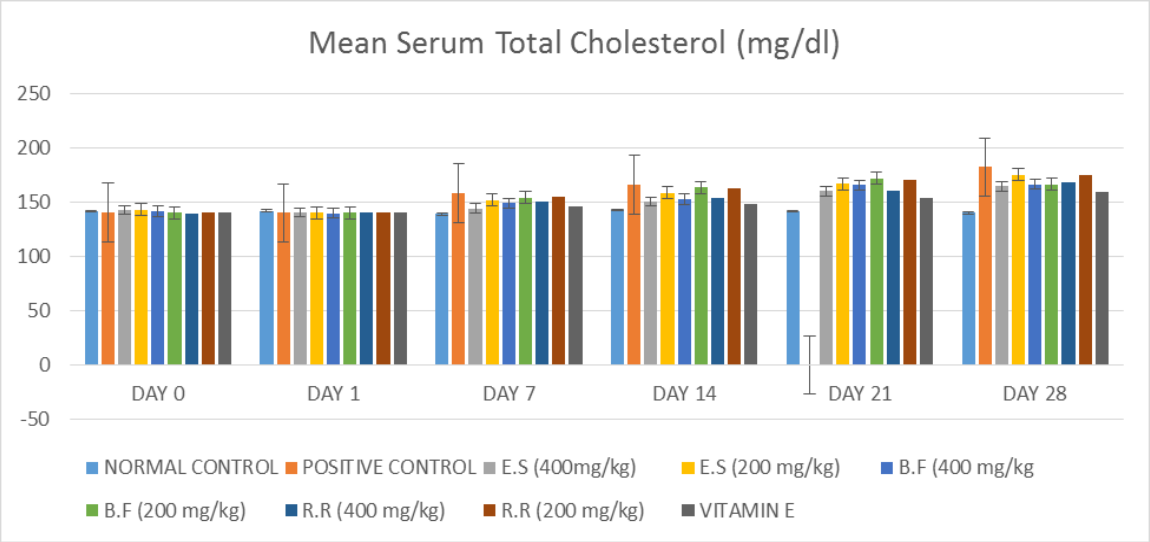

Figure 1: Serum total cholesterol in control and petrol fume exposed rats treated with aqueous extracts of *Emilia sonchifolia* (E.S.), *Bridellia ferruginea* (B.F.) and *Rhizophora racemosa* (R.R.) for 28 days.

The findings are shown as mean ± SEM. A statistically significant difference from the control group is denoted at $p < 0.05$.

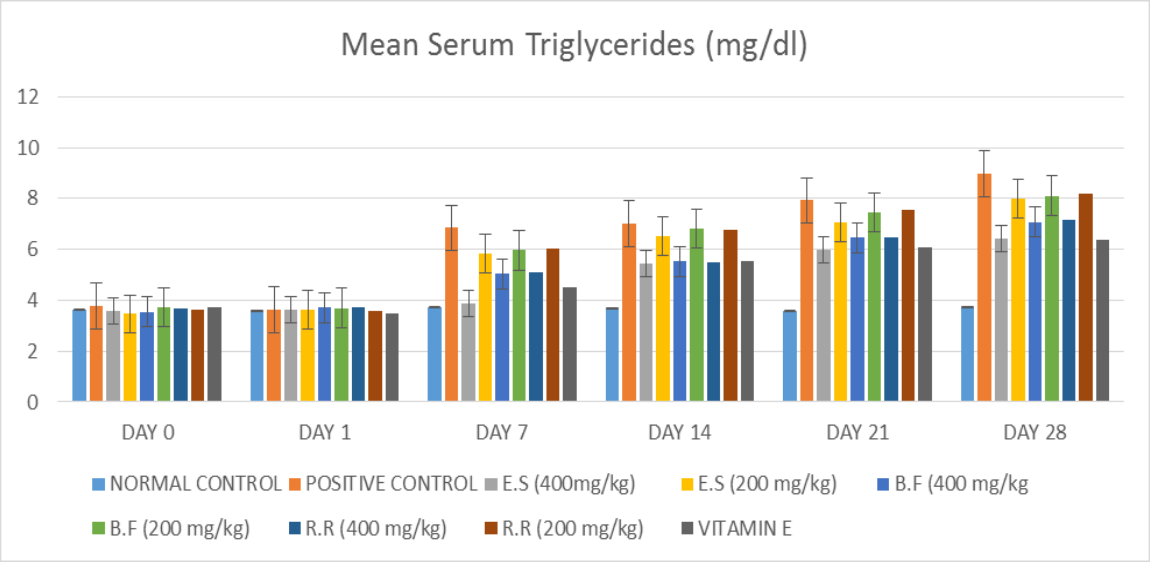

Figure 2: Serum triglycerides in control and petrol fume–exposed rats treated with aqueous extracts of *Emilia sonchifolia* (E.S.), *Bridellia ferruginea* (B.F.), and *Rhizophora racemosa* (R.R.) for 28 days.

The findings are shown as mean ± SEM. A statistically significant difference from the control group is denoted at $p < 0.05$.

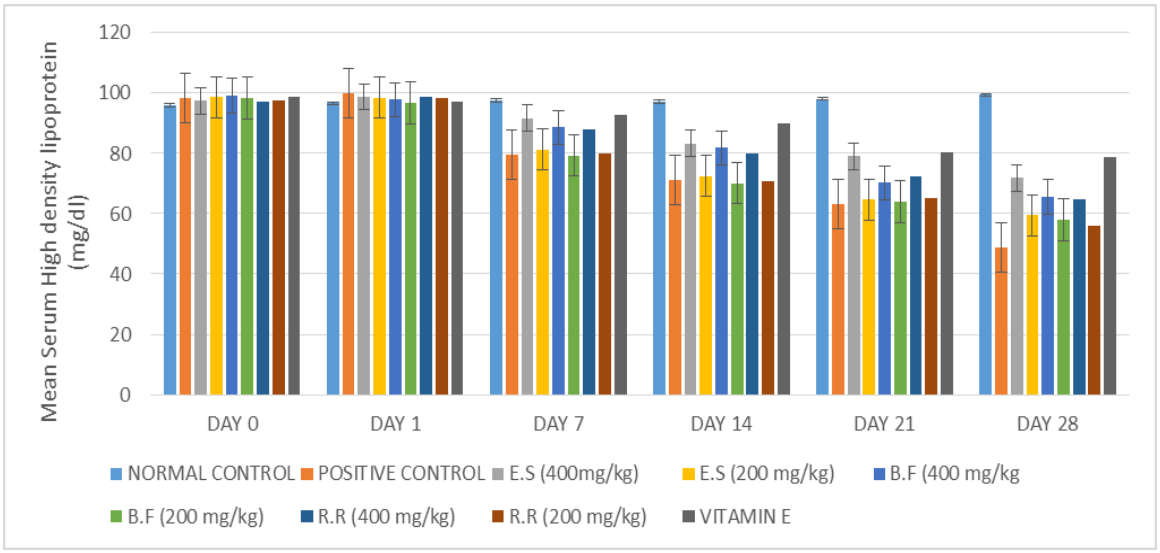

Figure 3: Serum HDL in control and petrol fume–exposed rats treated with aqueous extracts of *Emilia sonchifolia* (E.S.), *Bridellia ferruginea* (B.F.), and *Rhizophora racemosa* (R.R.) for 28 days.

The findings are shown as mean ± SEM. A statistically significant difference from the control group is denoted at $p < 0.05$.

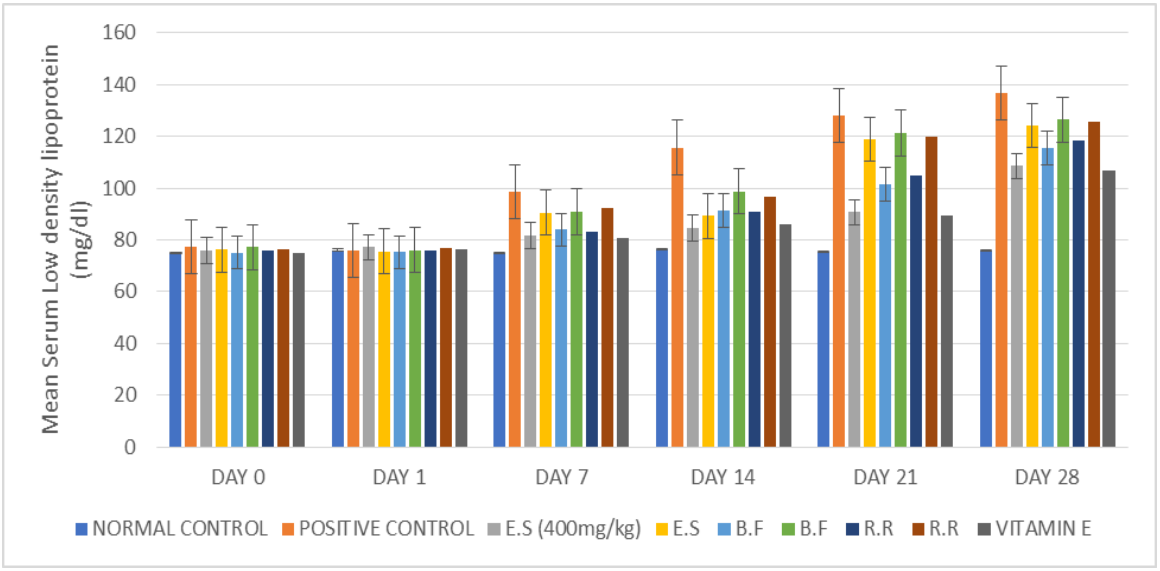

Figure 4: Serum HDL in control and petrol fume–exposed rats treated with aqueous extracts of *Emilia sonchifolia* (E.S.), *Bridellia ferruginea* (B.F.), and *Rhizophora racemosa* (R.R.) for 28 days.

The findings are shown as mean ± SEM. A statistically significant difference from the control group is denoted at $p < 0.05$.

DISCUSSION

Findings from this research show that Wistar rats exposed to petrol fumes developed significant abnormalities in lipid parameters, including raised total cholesterol, triglycerides and LDL, along with reduction in HDL levels. These results align with previous studies indicating that exposure to hydrocarbons promotes oxidative stress (Umićević *et al.*, 2024), disrupts lipid metabolism, and predisposes to cardiovascular risk (Uboh *et al.*, 2007; Chen *et al.*, 2023). The observed alterations became evident after seven days of exposure and persisted through day 28, suggesting cumulative toxic effects of prolonged inhalation of petrol fumes.

The pronounced increase in total cholesterol and triglycerides among exposed rats aligns with the findings of Uboh et al. (2007), who reported dyslipidemia in rats exposed to petrol vapors. The mechanism underlying this effect has been linked to hydrocarbon-induced oxidative stress, which impairs hepatic lipid regulation and promotes lipid peroxidation (Rizk *et al.*, 2020). Elevated LDL and reduced HDL further indicate a shift towards an atherogenic lipid profile, thereby increasing the risk of

cardiovascular complications. These outcomes align with the results reported by Adegoke et al. (2020), who observed comparable dyslipidemic alterations in male Wistar rats following exposure to petrol fumes.

Treatment with aqueous extracts from *Emilia sonchifolia*, *Bridelia ferruginea* and *Rhizophora racemosa* produced a significant, dose-dependent restoration of lipid profile parameters. The higher dose of 400 mg/kg demonstrated a more substantial therapeutic effect compared to the 200 mg/kg dose. These findings corroborate previous studies highlighting the lipid-lowering and antioxidant activities of these plants. For instance, *Emilia sonchifolia* has been reported to possess strong free radical scavenging ability and hypolipidemic effects in hypercholesterolemic models (Emmanuel *et al.*, 2020; Jeeno *et al.*, 2023; Ajen *et al.*, 2023). Similarly, *Bridellia ferruginea* has been shown to modulate lipid metabolism and protect against oxidative damage in experimental animals (Oyebode *et al.*, 2022). *Rhizophora racemosa*, traditionally used for its hepatoprotective and anti-inflammatory properties, also contains polyphenolic compounds that attenuate lipid peroxidation and improve serum lipid profile (Ariwaodo *et al.*, 2024).

Interestingly, the protective effects observed in the plant extract groups were comparable to those produced by vitamin E, a well-established antioxidant. Vitamin E treatment significantly reduced total cholesterol, triglycerides, and LDL levels while increasing HDL, consistent with previous reports on its cardioprotective role in oxidative stress conditions (Fatima, *et al.*, 2025). However, the higher dose (400 mg/kg) of the plant extracts demonstrated lipid-modulating effects that were in some cases similar to or slightly superior to vitamin E, suggesting that the phytochemicals in these plants may offer synergistic antioxidant and hypolipidemic benefits.

The dose-dependent improvement in lipid profile further supports the therapeutic potential of these medicinal plants. Phytochemicals such as flavonoids, tannins, saponins, and alkaloids, which are abundant in the studied plants, have been reported to regulate lipid metabolism by enhancing antioxidant enzyme activity, reducing hepatic cholesterol synthesis, and improving lipoprotein balance (Eilam *et al.*, 2022; Camilleri and Blundell, 2024). This mechanism likely explains the reversal of dyslipidemia observed in the treated groups.

The results of this study provide strong evidence that *Emilia sonchifolia*, *Bridellia ferruginea*, and *Rhizophora racemosa* possess protective properties against petrol fume-induced lipid abnormalities. These findings are in agreement with previous reports on the protective roles of medicinal plants against hydrocarbon-induced toxicity and oxidative stress (Barathan, *et al.*, 2024). By restoring lipid homeostasis, these plants may reduce the cardiovascular risks associated with prolonged exposure to petroleum hydrocarbons.

CONCLUSION

This study shows that prolonged exposure to petrol fumes causes dyslipidemia in Wistar rats, evidenced by increased total cholesterol, triglycerides, and LDL with reduced HDL, reflecting heightened cardiovascular risk. Aqueous extracts of *Emilia sonchifolia*, *Bridellia ferruginea*, and *Rhizophora racemosa* effectively reversed these abnormalities in a dose-dependent manner, with 400 mg/kg proving most potent. Their hypolipidemic and antioxidant effects, comparable or superior to vitamin E, are attributed to phytochemicals that restore lipid metabolism and reduce oxidative stress. These findings reinforce the cardioprotective and therapeutic potential of these plants against hydrocarbon-induced metabolic disturbances. Further studies should isolate active compounds, evaluate long-term safety, and explore clinical applications in humans, particularly.

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