



Experimental Evaluation of the Effects of Selected Leaf Extracts on the Lipid Profile of Wistar Rats

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ABSTRACT

Original Research Article

Dyslipidaemia is a major modifiable risk factor for cardiovascular disease; and plant-derived bioactive compounds are increasingly investigated for lipid management. This study assessed the hypolipidaemic effects of aqueous leaf extracts of *Solanum aethiopicum* (SA), *Amaranthus hybridus* (AH), *Pterocarpus mildbraedii* (PM), *Ocimum gratissimum* (OG) and *Telfairia occidentalis* (TO) in male Wistar rats over 60 days. Animals were assigned to a control group or to treatment with each extract at low, medium, or high doses. Serum total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) were measured using standard assay kits. Dose had a significant effect on TC ($F = 4.539$, $p = 0.014$), whereas extract type and the interaction were not significant. Numerically, SA produced the largest TC reduction, decreasing from 79.58 ± 7.35 mg/dL in controls to 50.85 ± 1.07 mg/dL at high dose, followed by PM (~ 62 – 63 mg/dL) and TO (64.75 ± 0.60 mg/dL). TG declined without statistical significance ($F = 2.244$, $p = 0.115$); SA decreased TG from 219.83 ± 8.96 to 193.36 ± 7.75 mg/dL. HDL increased significantly with both dose ($F = 45.016$, $p < 0.001$) and vegetable ($F = 17.210$, $p < 0.001$), peaking in PM (19.63 ± 1.48 mg/dL) and TO (17.44 ± 0.12 mg/dL) versus control (10.38 ± 0.78 mg/dL). LDL showed modest dose-related reductions ($F = 2.776$, $p = 0.068$). The extracts produced dose-dependent TC lowering and pronounced HDL elevation, with SA, PM and TO showing the most favourable numerical effects.

Keywords: Hypolipidaemia, Leaf Extracts, Lipid Profile, Wistar Rats, LDL.

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Introduction

Dyslipidaemia remains a major global health concern because it plays a central role in the development of cardiovascular diseases, which account for a significant proportion of morbidity and mortality worldwide (Du & Qin, 2023). Abnormal levels of total cholesterol, triglycerides, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol are often linked to metabolic disorders, poor dietary habits and sedentary lifestyles (Khanali et al., 2023; Park et al., 2020). Conventional lipid-lowering drugs, such as statins and fibrates, have proven effective, yet their long-term use is often limited by adverse effects including hepatotoxicity, muscle complications, and patient intolerance

(Krähenbühl et al., 2016; Muscari et al., 2002). These limitations have encouraged the exploration of natural plant-based alternatives with potential lipid-modulating properties.

Medicinal plants have historically played an important role in primary healthcare, particularly in Africa and Asia, where traditional medicine is deeply integrated into cultural practices (Oubré et al., 1997). Several plant species are rich in bioactive compounds such as flavonoids, alkaloids, tannins, saponins, and phenolic acids, which are generally associated with various pharmacological effects including neuroprotective, anti-inflammatory, antioxidant, and metabolic regulatory activities (Nandabaram et al., 2026). These phytochemicals can influence lipid metabolism by

reducing intestinal cholesterol absorption, enhancing bile acid excretion, modulating hepatic lipid synthesis, and improving antioxidant defense mechanisms (Alam et al., 2016). As a result, plant extracts have gained growing scientific interest for their potential hypolipidemic activity.

Animal models, including Wistar rats, are used in evaluating the biochemical effects of plant extracts (Hu et al., 2022). Experimental studies using rats have demonstrated that certain leaf extracts can significantly alter serum lipid markers, suggesting possible therapeutic applications. For example, extracts from *Vernonia amygdalina* and *Azadirachta indica* have been shown to reduce total cholesterol and triglycerides while improving high-density lipoprotein levels (Offor et al., 2014).

Despite these promising findings, the lipid-modulating potential of many locally available plants remains poorly understood, and comparative evaluations of different leaf extracts are limited. This gap underscores the need for systematic experimental studies that investigate their effects on lipid metabolism under controlled conditions. Understanding how selected plant leaves influence lipid profiles in Wistar rats not only contributes to scientific knowledge but may also support the development of safer, cost-effective therapeutic agents derived from natural sources.

Therefore, the present study evaluates the effects of selected leaf extracts on the lipid profile of Wistar rats, with the aim of providing empirical evidence that supports or challenges their potential use in managing dyslipidemia

Materials and Methods

Plant Material Collection, Authentication, and Extract Preparation

Fresh leaf samples of *Solanum aethiopicum* (SA), *Amaranthus hybridus* (AH), *Pterocarpus mildbraedii* (PM), *Ocimum gratissimum* (OG), and *Telfairia occidentalis* (TO) were purchased from a local market in Effurun, Delta State, Nigeria. Experts in the Department of Environmental Management and Toxicology, College of Sciences, Federal University of Petroleum Resources, Effurun, carried out taxonomic identification and confirmation. The leaves were cleaned, air-dried at ambient laboratory temperature (30 ± 2 °C) until they became brittle, coarsely pulverized with a mortar and pestle, and subsequently milled into fine powder using a Viking Exclusive Joncod grinder (Model YLH2M2-4).

For aqueous extraction, 25 g of powdered leaves from each plant species were immersed in 250 mL of distilled water and left to stand for 48 h with occasional stirring. The mixtures were then filtered through Whatman No. 1 filter paper, and the resulting filtrates were freeze-dried to obtain solid extracts. Before administration, extracts were redissolved in

distilled water at the desired concentrations. The extraction method followed established pharmacognostic protocols (Osolaja & Ibezute, 2025).

Previous toxicological investigations indicated that the median lethal dose (LD₅₀) of these extracts in Wistar rats exceeds 5000 mg/kg body weight, suggesting negligible acute toxicity (Ibezute & Oshone, 2025). Accordingly, the dosages adopted in this study were selected from within the established safety margins.

Experimental Animals and Treatment

Male Wistar rats (6–7 weeks old, 125–150 g) were procured from the Department of Anatomy, University of Benin, Nigeria. The animals underwent a two-week acclimatization period under standard laboratory conditions (22 ± 2 °C; 12 h light/dark cycle) with unrestricted access to commercial rodent feed (Bendel Livestock Feeds Ltd., Ewu, Edo State, Nigeria) and distilled water. At 8–9 weeks of age, the rats were randomly allocated into six experimental groups comprising one control group and five treatment groups corresponding to the respective leaf extracts (SA, AH, PM, OG, TO). Each treatment group consisted of five rats ($n = 5$) and was further subdivided into three dosage levels (100, 200, and 300 mg/kg body weight). Extracts were administered orally by gavage once every 48 hours, and all preparations were homogenized immediately before dosing. The exposure period lasted for 60 days.

At the end of the experiment, rats were fasted overnight and euthanised under light anaesthesia. Blood samples were collected via cardiac puncture using sterile syringes, transferred into plain tubes, allowed to clot, and centrifuged to obtain serum. The serum samples were subsequently stored at -80 °C until biochemical analyses were conducted in accordance with established procedures.

Biochemical Assays

Biochemical evaluation of serum was conducted to determine relevant health indices. Lipid profile assessment included quantification of total cholesterol, triglycerides, high-density lipoprotein (HDL) and low-density lipoprotein (LDL). The analyses were performed with commercially available diagnostic kits in accordance with the manufacturer's protocols; optical densities were read using a spectrophotometer (Model SP-300, OPTIMA, Japan).

Statistical Analysis

All results were expressed as mean \pm standard error (SE). Statistical analyses were carried out using SPSS and Microsoft Excel. A two-way analysis of variance (ANOVA) was applied to evaluate the main effects of treatment and dose, as well as their interaction, on the measured parameters. Where significant variations were detected, Duncan's Multiple Range Test was used for post hoc comparisons. Statistical significance was considered at $p < 0.05$.

Results and Discussion

The results of this study showed a significant dose-dependent effect of the leaf extracts on total cholesterol levels in male Wistar rats ($F = 4.539$, $p = 0.014$). The effect of vegetable type and the dose-vegetable interaction were not statistically significant, which means that although increasing the dose improved the cholesterol-lowering effect, the vegetables did not differ statistically from one another in their impact on total cholesterol. The numerical patterns, however, provide useful descriptive insight into how the extracts behaved across doses.

Solanum aethiopicum showed the largest numerical reduction, with values falling from 79.58 ± 7.35 mg/dL in the control group to 50.85 ± 1.07 mg/dL at the highest dose. Although these reductions were not statistically distinguishable from those of the other vegetables, they align with previous reports that *S. aethiopicum* possesses lipid-lowering activity, partly through mechanisms such as inhibition of HMG-CoA reductase (Lela et al., 2023).

Pterocarpus mildbraedii likewise produced notable reductions, with cholesterol decreasing from 79.58 ± 7.35 mg/dL in the control to roughly 62–63 mg/dL across

treatment groups. This pattern is consistent with earlier studies showing that *Pterocarpus* species, including *Pterocarpus marsupium*, reduce serum lipid levels in rodents and contain flavonoids (Garg et al., 2026). *Telfairia occidentalis* also showed consistent dose-related reductions, reaching 64.75 ± 0.60 mg/dL at the highest dose. Previous work has similarly reported decreases in total and low-density lipoprotein cholesterol following supplementation with *T. occidentalis*, along with antioxidant effects that may support lipid regulation (Dimeji et al., 2021).

Ocimum gratissimum produced moderate numerical reductions, reaching 65.47 ± 2.35 mg/dL at the highest dose, in agreement with reports that its extracts lower serum cholesterol in hyperlipidaemic rodent models (Anyanwu & Ogbadu, 2024; Uzor et al., 2025). In contrast, *Amaranthus hybridus* showed minimal reduction, with cholesterol remaining close to control values (79.58 ± 7.35 mg/dL in control versus 73.40 ± 2.69 mg/dL at high dose). This limited effect differs from some studies on *Amaranthus* species, although lipid-lowering activity can vary with species, plant part and processing conditions that influence the bioavailability of compounds such as phytosterols and squalene (Waisundara et al., 2019; Wołosik & Markowska, 2019).

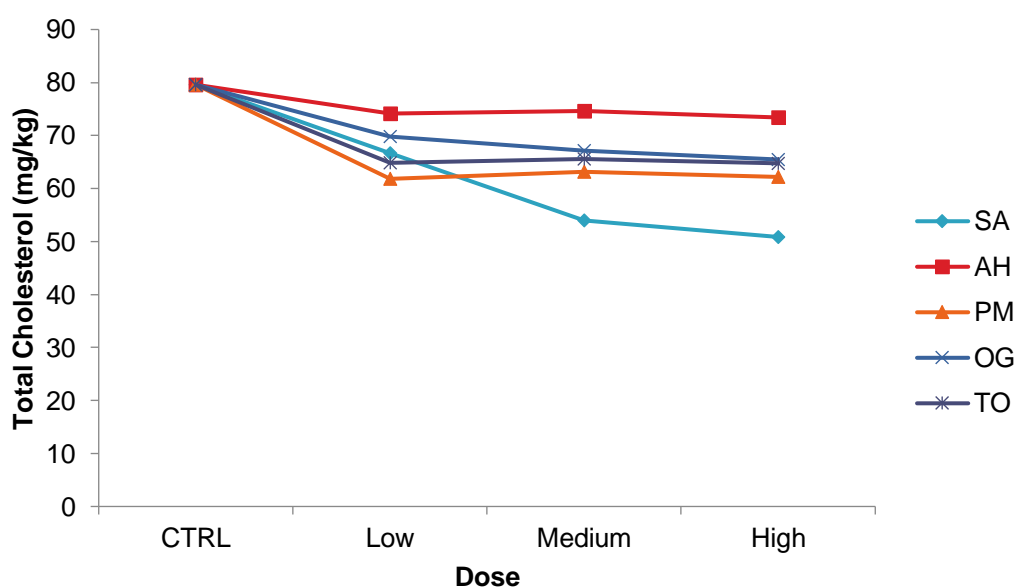


Figure 1. Interaction plot for the total cholesterol levels across different doses and leaf extracts.

Solanum aethiopicum = SA; *Amaranthus hybridus* = AH; *Pterocarpus mildbraedii* = PM; *Ocimum gratissimum* = OG; *Telfairia occidentalis* (TO)

Table 1. Summary table of two-way ANOVA on the interaction for total cholesterol levels across different doses and leaf extracts.

Source	F	Sig.	Partial Eta Squared
Dose	4.539	0.014	0.405
Vegetable	0.770	0.557	0.133
Dose * Vegetable	1.049	0.447	0.386

In addition to cholesterol, the administration of different leaf extracts produced reductions in serum triglycerides (TG). However, these changes were not statistically significant, as

shown by two-way ANOVA results (Dose: $F = 2.244$, $p = 0.115$; Vegetable: $F = 0.804$, $p = 0.537$; Dose \times Vegetable: $F = 0.947$, $p = 0.524$). Despite this, a downward trend in TG

levels was observed across treatments compared with the control (219.83 ± 8.96 mg/dL). The strongest effect was recorded for *S. aethiopicum*, which reduced TG levels from 219.83 ± 8.96 mg/dL (control) to 193.36 ± 7.75 mg/dL at the high dose. This finding supports earlier research indicating that *S. aethiopicum* contains bioactive phytochemicals, including phenolic acids which modulate lipid metabolism and may reduce triglyceride synthesis (Ponticelli et al., 2023). *A. hybridus* produced moderate decreases, lowering TG to 204.85 ± 9.31 mg/dL at high dose, consistent with evidence that *Amaranthus* supplementation attenuates hyperlipidaemia in animal models through dietary fibre and phytosterols (Sisti et al., 2019).

By contrast, the effects of *P. mildbraedii* and *T. occidentalis* were comparatively small, with high-dose values of 209.79 ± 6.12 mg/dL and 211.69 ± 0.44 mg/dL, respectively. *O. gratissimum* demonstrated moderate activity, reducing TG to 202.50 ± 2.40 mg/dL at the highest dose, which aligns with its reported lipid-lowering properties (Anyanwu & Ogbadu, 2024). Although not significant, the downward trend suggests potential triglyceride-lowering activity, particularly for *S. aethiopicum*. The lack of significance may reflect inter-group variability, sample size limitations, or the relatively short treatment duration. These findings are consistent with previous reports, that note phytochemicals have beneficial effects on lipid parameters, reducing triglycerides and cholesterol (Tehrani et al., 2023).

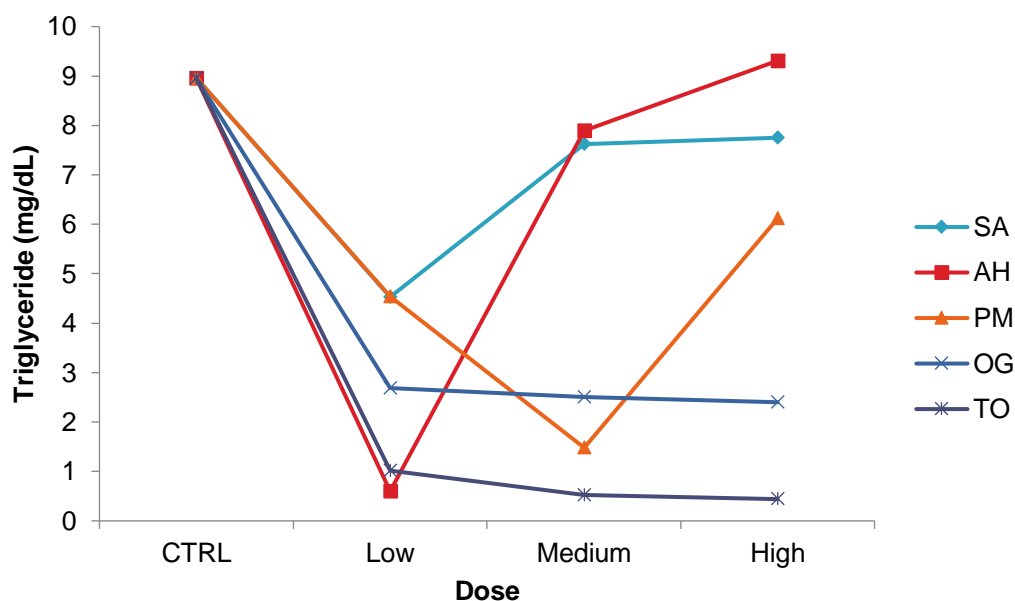


Figure 2. Interaction plot for triglyceride levels across different doses and leaf extracts.

Solanum aethiopicum= SA; *Amaranthus hybridus* = AH; *Pterocarpus mildbraedii*= PM; *Ocimum gratissimum* = OG; *Telfaria occidentalis*= TO

Table 2. Summary table of two-way ANOVA on the interaction for triglyceride levels across different doses and leaf extracts.

Source	F	Sig.	Partial Eta Squared
Dose	2.244	0.115	0.252
Vegetable	0.804	0.537	0.139
Dose * Vegetable	0.947	0.524	0.362

With respect to high-density lipoprotein (HDL), the results revealed a significant and consistent increase across all treatments, with both dose and vegetable type exerting strong effects (Dose: $F = 45.016$, $p < 0.001$; Vegetable: $F = 17.210$, $p < 0.001$). The baseline control group recorded an HDL level of 10.38 ± 0.78 mg/dL. Treatment with *S. aethiopicum* increased HDL to 15.01 ± 0.16 mg/dL at the highest dose, while *A. hybridus* produced a similar rise to 14.16 ± 0.14 mg/dL. *T. occidentalis* elicited a more pronounced effect, elevating HDL to 17.44 ± 0.12 mg/dL at the highest dose. The strongest response was observed with *P. mildbraedii*, which markedly raised HDL to 19.63 ± 1.48 mg/dL. *O. gratissimum* also enhanced HDL levels, though less strongly, reaching 14.95 ± 0.23 mg/dL at the highest dose.

These results highlight the cardioprotective potential of the studied vegetables, given that elevated HDL is associated with reverse cholesterol transport and reduced risk of atherosclerosis (Lee et al., 2008; Rothblat & Phillips, 2010). Similar HDL increases have been reported following *T. occidentalis* supplementation (Ugwu et al., 2011) and *O. gratissimum* treatment (Chao et al., 2016). The marked effect observed with *P. mildbraedii* supports earlier evidence that its phytochemicals strongly modulate lipid metabolism (Marrelli et al., 2016). The dose-dependent increases observed here confirm that the lipid-modulating activity of these vegetables is closely linked to their phytochemical concentrations.

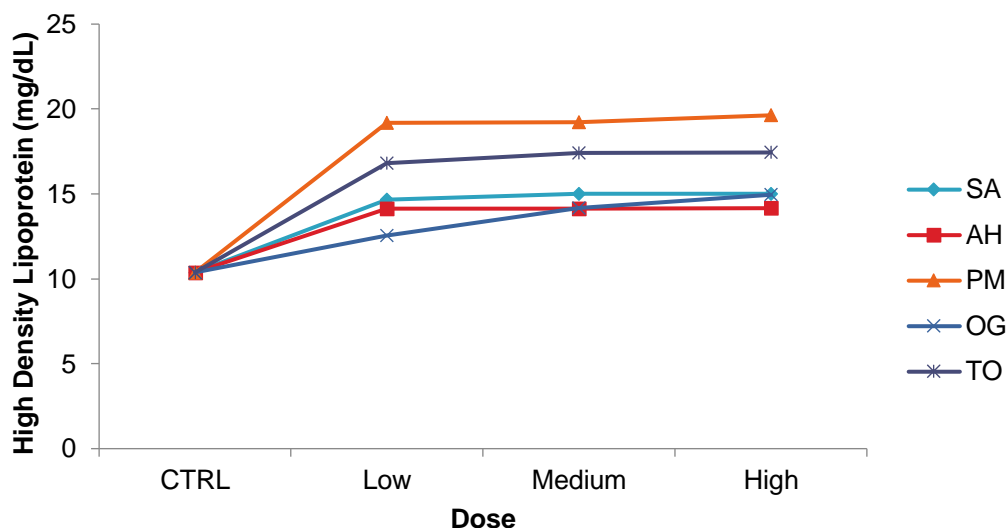


Figure 3. Interaction plot for high density lipoprotein levels across different doses and leaf extracts.

NB: *Solanum aethiopicum*= SA; *Amaranthus hybridus* = AH; *Pterocarpus mildraedii*= PM; *Ocimum gratissimum* = OG; *Telfaria occidentalis*= TO

Table 3. Summary table of two-way ANOVA on the interaction for high density lipoprotein levels across different doses and leaf extracts.

Source	F	Sig.	Partial Eta Squared
Dose	45.016	0.000	0.871
Vegetable	17.210	0.000	0.775
Dose * Vegetable	2.839	0.019	0.630

Finally, the analysis of low-density lipoprotein (LDL) concentrations showed modest reductions following extract administration. The control group recorded 24.79 ± 6.34 mg/dL, while *S. aethiopicum* produced a dose-dependent decline to 16.50 ± 9.36 mg/dL at the high dose. *A. hybridus*, *P. mildbraedii*, *O. gratissimum*, and *T. occidentalis* also showed gradual declines, although the magnitude of reduction was small. The two-way ANOVA revealed that the

effect of dose approached significance ($F = 2.776$, $p = 0.068$, $\eta^2 = 0.294$), suggesting a possible dose-related trend, but the vegetable type and dose-vegetable interaction were not significant. These results indicate that LDL-lowering was generally modest and not specific to any vegetable, aligning with evidence that flavonoids and saponins enhance LDL clearance but often produce subtler effects compared to total cholesterol and HDL modulation (Islam et al., 2021; Umami et al., 2022).

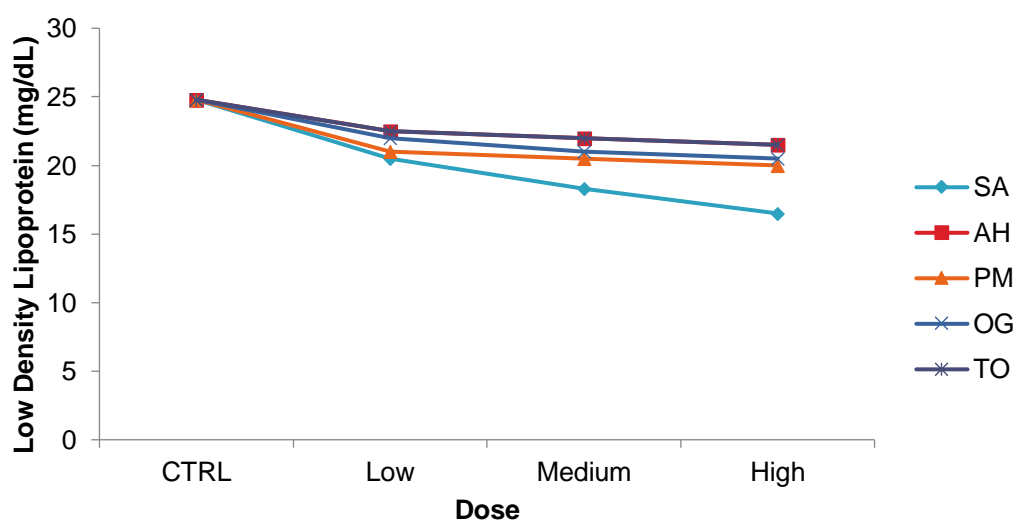


Figure 4. Interaction plot for low density lipoprotein levels across different doses and leaf extracts.

NB: *Solanum aethiopicum*= SA; *Amaranthus hybridus* = AH; *Pterocarpus mildraedii*= PM; *Ocimum gratissimum* = OG; *Telfaria occidentalis*= TO

Table 4. Summary table of two-way ANOVA on the interaction for low density lipoprotein levels across different doses and leaf extracts.

Source	F	Sig.	Partial Eta Squared
Dose	2.776	0.068	0.294
Vegetable	1.043	0.410	0.173
Dose * Vegetable	0.875	0.583	0.344

Conclusion

The study provides experimental evidence that the evaluated leaf extracts possess lipid-regulating potential and may contribute to improved cardiovascular health when used appropriately. Their ability to enhance HDL and attenuate cholesterol accumulation supports their traditional use and highlights their possible value as natural adjuncts in the management of dyslipidemia. Further investigation is needed to characterize the specific phytochemical constituents responsible for these effects and to clarify the molecular pathways through which they act, including studies involving longer treatment periods, larger sample sizes, and standardized extraction protocols.

Ethical Approval

This research design was reviewed and approved by the College of Science Ethics Board, Federal University of Petroleum Resources, Effurun (CS/EMT/2025/006).

Competing Interests

Authors have declared that no competing interests exist.

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