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Effect of Slimming Teas on Lipid Profile and Antioxidant Status in High-Fat Diet-Induced Hyperlipidemic Female Albino Rats

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Abstract:

Background and Objective: Herbal slimming teas are widely consumed in Nigeria for weight management, yet scientific data on their metabolic effects remain limited. This study evaluated the impact of two commercially available slimming teas on lipid profile and antioxidant status in high-fat diet-induced hyperlipidemic female albino rats. **Materials and Methods:** Forty-two female albino rats (250–300 g) were divided into seven groups (n=6). Hyperlipidemia was induced with a high-fat diet for 15 days. Rats then received daily oral treatments for 21 days: normal control, hyperlipidemic control, simvastatin, one of two slimming teas (Tea 1 or Tea 2) at 200 or 400 mg/kg. Serum lipid profile and antioxidant markers (GSH, GST, GPX, CAT, SOD, MDA) were measured. Data were analysed by one-way ANOVA followed by Tukey's post-hoc test ($p \leq 0.05$). **Results:** Hyperlipidemia induction was successfully confirmed. Administration of both slimming teas produced no statistically significant changes in serum TC, TG, HDL, LDL, or VLDL levels compared to the hyperlipidemic control ($p \leq 0.05$). Antioxidant markers showed mostly non-significant effects, with modest elevations in GSH at lower doses but no consistent changes in MDA or other enzymes. Body weight gain was lower in high-dose tea groups. **Conclusion:** The tested slimming teas demonstrated limited effects on lipid profile and antioxidant status in this hyperlipidemic model. While trends toward modest modulation were observed, larger, longer-term studies are needed to fully establish efficacy and safety.

Keywords: Slimming tea, hyperlipidemia, lipid profile, antioxidant status, oxidative stress, rat model, high-fat diet

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INTRODUCTION

Obesity and hyperlipidemia are major public health challenges globally (Jin et al., 2023). In response, many individuals in Nigeria turn to commercially available herbal slimming teas, often perceived as natural and safe (Ivanova et al., 2021). However, rigorous scientific evaluation of their metabolic effects is limited (Petrovska, 2012).

Slimming teas often contain polyphenols and other bioactive compounds that may influence lipid metabolism and antioxidant status (Lin & Lin-Shiau, 2006). Studies on various teas, including green, black, oolong, and Pu-erh, have demonstrated potential hypolipidemic effects, such as reduced total cholesterol (TC), triglycerides (TG), and low-density lipoprotein (LDL) levels, alongside increased high-density lipoprotein (HDL) (Hou et al., 2009; Muramatsu et al., 1986; Mohammed et al., 2024). These teas also exhibit antioxidant properties, elevating superoxide dismutase (SOD), glutathione (GSH), and catalase (CAT) while lowering malondialdehyde (MDA) (Nwaine & Olorunfemi, 2018; Yan et al., 2009). For instance, Besunyen Slimming Tea and Shahana tea have shown liver-protective effects in rat models (Chingwen Yu et al., 2023; Mohammed et al., 2024).

Recent systematic reviews indicate that green tea supplementation may improve lipid profiles in animal models, though human studies show inconsistent results (Macedo et al., 2022; Neyestani & Neyestani, 2022). A 2023 review highlighted improvements in cardiovascular risk factors with green tea, but emphasized variability across studies (Asbaghi et al., 2023). Similarly, a 2024 comparative study on herbal products noted positive effects on lipid metabolism in rat models (Mohammed et al., 2024).

Biochemical disorders like hyperlipidemia increase susceptibility to cardiovascular diseases and oxidative stress (Barr, 2018; Suriyaprom et al., 2019). Slimming teas, categorized as appetite suppressors, fat blockers, or metabolism boosters, theoretically aid weight loss by suppressing appetite, detoxifying, or enhancing calorie burn (Odinga et al., 2016). However, some may contain harmful ingredients, with limited evidence for long-term efficacy (Alloubani et al., 2021). Focusing on female models addresses sex-specific gaps in hyperlipidemia research (Suriyaprom et al., 2019) and examining the hepatorenal profiles of two widely consumed slimming teas in a high-fat diet-induced hyperlipidemic female rat model (Odinga-Israel et al,2024). This study aimed to assess the impact of two slimming teas on lipid profiles (TC, LDL, HDL, TG) and antioxidant status in hyperlipidemic female rats, using established protocols (El-Missiry et al., 2013).

METHODOLOGY

Ethical Statement: The study protocol was conducted in accordance with ARRIVE 2.0 guidelines (Percie du Sert et al., 2020).

Experimental Animals: Forty-two adult female albino rats (250–300 g) were obtained from the Rivers State University Animal House and acclimatized for 7 days under standard conditions (12-h light/dark cycle, 22–25°C, *ad libitum* feed and water).

Induction of Hyperlipidemia: Hyperlipidemia was induced using a high-fat diet (68% normal chow, 20% milk powder, 6% corn oil, 6% ghee; 414 kcal/100 g (Abdul Kadir et al. (2015) for 15 days. Induction was confirmed by elevated serum lipids.

Tea Preparation and Dosing: Two commercial slimming teas (Tea 1: Healthy Hour Fat Burner; Tea 2: Tummy and Fat Reducing Tea) were prepared as infusions (2 g in 50 mL distilled water at 80°C for 10 min). Doses of 200 and 400 mg/kg body weight (dry weight equivalent) were administered daily by oral gavage for 21 days. (Odinga et al., 2020).

Experimental Groups

Group 1: Normal control

Group 2: Hyperlipidemic control (HFD only)

Group 3: HFD + simvastatin

Groups 4-5: HFD + Tea 1 (200 & 400 mg/kg)

Groups 6-7: HFD + Tea 2 (200 & 400 mg/kg)

Biochemical Analysis Serum lipid profile (TC, TG, HDL) was measured enzymatically; TC (Stockbridge et al., 1989), TG (Annoni et al., 1982), HDL (Assmann, 1979). LDL was calculated as LDL = TC - HDL - (TG/5) (Odinga et al., 2020). LDL was calculated using the Friedewald formula.

Antioxidant markers (GSH, GST, GPX, CAT, SOD, MDA) were assayed using standard spectrophotometric methods. : MDA (Bahekar & Kale, 2016), SOD (Bahekar & Kale, 2016), GSH (Gabriel-Brisibe et al., 2020), CAT (Bahekar & Kale, 2016; Gabriel-Brisibe et al., 2020).

Data Analysis: Results are expressed as mean ± SD. One-way ANOVA with Tukey's post-hoc test was performed (IBM SPSS v27). Significance was set at $p \leq 0.05$. Effect sizes (η^2) were calculated.

RESULTS

Body Weight Changes: Administration of the slimming teas resulted in a reduced percentage body weight gain compared with both the normal and hyperlipidemic control groups. The effect was more pronounced at the higher dose (400 mg/kg) of both Tea 1 and Tea 2 (Table 1).

Antioxidant Status: One-way ANOVA revealed no statistically significant differences across treatment groups for glutathione-S-transferase (GST), glutathione peroxidase (GPX), malondialdehyde (MDA), catalase (CAT), and superoxide dismutase (SOD) levels ($p > 0.05$). Modest post-hoc increases in reduced glutathione (GSH) were observed in some low-dose tea groups compared to respective controls, but overall antioxidant effects were limited (Table 2).

Table 1: Percentage Body Weight Difference in Experimental Rats

Group	Initial Weight (g)	Final Weight (g)	% Body Weight Change
Normal Control	129.50 ± 19.87	177.50 ± 23.32	37.10 ± 5.2
Hyperlipidemic Control (HFD)	175.83 ± 6.77	202.50 ± 10.52	15.17 ± 3.8
HFD + Simvastatin	176.83 ± 8.89	209.33 ± 23.44	18.38 ± 4.1
HFD + Tea 1 (200 mg/kg)	148.83 ± 7.14	178.50 ± 16.16	19.94 ± 4.6
HFD + Tea 1 (400 mg/kg)	140.67 ± 7.92	151.00 ± 8.34	7.34 ± 2.9
HFD + Tea 2 (200 mg/kg)	151.00 ± 5.76	175.67 ± 19.70	16.34 ± 3.5
HFD + Tea 2 (400 mg/kg)	159.12 ± 14.96	165.50 ± 16.37	4.01 ± 2.1

Values are mean ± SD (n=6). High-dose tea groups showed significantly lower body weight gain compared to controls ($p < 0.05$). Body weight differences (% BWD) were calculated as [(final weight - initial weight)/initial weight] × 100 (Odinga et al., 2023).

Table 2: Antioxidant Status of Experimental Rats (Overall Means)

Groups	GST (umol)	GSH (umol)	GPX (umol)	MDA (umol)	CAT (umol)	SOD (umol)
Normal Control	0.32 ± 0.08^a	1.76 ± 0.40^a	0.08 ± 0.02^a	0.61 ± 0.05^a	5.6 ± 0.57^a	0.19 ± 0.05^a
Negative Control	0.24 ± 0.23^b	0.68 ± 0.31^a	0.08 ± 0.09^a	0.58 ± 0.60^a	4.8 ± 0.6^a	0.21 ± 0.07^a
Positive Control	0.30 ± 0.27^c	0.98 ± 0.16^a	0.21 ± 0.41^a	0.41 ± 0.09^a	5.6 ± 0.96^a	0.31 ± 0.12^a
200mg/kg Tea 1	0.27 ± 0.17^d	0.97 ± 0.42^a	0.05 ± 0.02^a	0.51 ± 0.10^a	4.7 ± 1.70^a	0.29 ± 0.09^a
400mg/kg Tea 1	0.24 ± 0.15^e	0.98 ± 0.27^a	0.04 ± 0.01^a	0.52 ± 0.15^a	4.4 ± 1.20^a	0.25 ± 0.12^a
200mg/kg Tea 2	0.34 ± 0.12^a	1.27 ± 0.23^a	0.27 ± 0.24^a	0.50 ± 0.71^a	5.8 ± 1.60^a	0.26 ± 0.74^a
400mg/kg Tea 2	0.22 ± 0.07^a	1.02 ± 0.16^a	0.04 ± 0.07^a	0.51 ± 0.75^a	5.00 ± 0.46^a	0.23 ± 0.62^a

Values are mean ± SD;(n=6) Superscripts indicate Tukey's post hoc comparisons ($p \leq .05$).

Lipid Profile: No statistically significant differences were observed in serum total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), or very low-density lipoprotein (VLDL) levels between the slimming tea-treated groups and the hyperlipidemic control ($p \leq 0.05$). Non-significant trends toward modest improvement in some lipid parameters were noted in certain tea-treated groups (Table 3).

Table 3 shows overall lipid means. No significant differences (*p* > .05 for all parameters, exact *F* and *p* not calculated due to uniform superscripts).

Groups	HDL (mmol)/L	TC (mmol)/L	TG (mmol)/L	LDL (mmol)/L	VLDL (mmol)/L
Normal control	1.27 ±0.23[a]	3.03 ±0.48 [a]	1.40 ±0.22 [a]	2.39 ±0.46 [a]	0.60±0.14 [a]
Negative control	1.31 ±0.27 [b]	2.70 ±0.69 [a]	1.27 ±0.41 [a]	1.94 ±0.80 [a]	0.55 ±0.16 [a]
Positive Control-simvastatin	1.43 ±0.21[c]	2.67 ±0.83[a]	1.18 ±0.23[a]	1.83±0.91[a]	0.60 ± 0.14[a]
200MG/KG Slim tea 1	1.32 ±0.13[d]	2.77 ±0.49[a]	1.15 ±0.13 [a]	2.04 ±0.67 [a]	0.50±0.07 [a]
400MG/KG Slim tea 1	1.37± 0.20 [e]	2.97±0.58 [a]	1.02 ±0.52 [a]	1.96 ±0.47 [a]	0.54 ±0.13[a]
200MG/KG Slim tea 2	1.54 ±0.33 [a]	3.48 ±0.53[a]	1.34 ±0.31 [a]	2.42 ±0.59 [a]	0.60 ± 0.16 [a]
400MG/KG Slim tea 2	1.37 ±0.13 [a]	2.55 ±0.21 [a]	1.10 ±0.10 [a]	1.80 ±0.18 [a]	0.55 ±0.13 [a]

Values are mean ± SD (n=6). No significant differences vs. hyperlipidemic control ($p \leq 0.05$)

DISCUSSION

Table 1 indicates that High-dose tea groups showed significantly attenuated weight gain compared to both Normal Control and HFD-C, consistent with a dose-dependent growth-suppressive or weight-reducing effect in the hyperlipidemic model.

Consistent with previous investigations on slimming teas, the present study found limited effects on lipid profile and antioxidant status in hyperlipidemic female rats (Mohammed et al., 2024; Muramatsu et al., 1986). However, non-significant trends toward modest improvement in some lipid parameters were noted in certain tea-treated groups requiring further study (Alloubani et al., 2021). The absence of robust lipid-lowering activity, despite marketed claims, aligns with findings from our earlier studies.

Most markers showed no significant differences vs. HFD-C except for modest GSH elevation in tea-treated groups. High intra-group variability noted in several parameters (e.g., MDA, SOD) as seen in table 2. Only glutathione showed modest elevation at the lower dose. No evidence of increased lipid peroxidation (MDA) or significant alterations in the major antioxidant enzymes (SOD, CAT, GPx, GST) was detected. These findings indicate that the administered doses and 21-day treatment duration did not produce detectable systemic oxidative stress under the study conditions. Modest GSH elevation without MDA rise or broad antioxidant depletion indicates limited oxidative stress under these conditions, possibly due to dose/duration or adaptive responses; the study was underpowered for some null endpoints.

The modest GSH elevation without corresponding changes in MDA or other antioxidant enzymes suggests a mild adaptive response rather than strong antioxidant capacity or overt oxidative stress at the tested doses. (Landis et al., 2012). This aligns with systematic reviews showing variable tea effects on lipids (Neyestani & Neyestani, 2022; Asbaghi et al., 2023). A 2025 review on tea in cardiovascular risk noted improvements in hyperlipidemia but emphasised dose and type variability (Stepien et al., 2025). These results highlight the gap between commercial claims and scientific evidence.

Lipid profile parameters (total cholesterol, triglycerides, LDL, HDL, VLDL) showed no statistically significant changes despite the hyperlipidemic induction and tea treatment. This null result contrasts with the marketed hypolipidemic claims of slimming teas and indicates that any potential polyphenol-related benefits were insufficient to overcome the toxic burden or were masked by the short treatment duration. The hyperlipidemic model was chosen deliberately to approximate the metabolic profile of the target consumer population — overweight or obese women of reproductive age who commonly present with dyslipidemia, the current metabolic data as shown in Table 3 indicate that any potential benefits on lipid metabolism or redox balance are modest at best with trends toward modest TC and LDL reduction in some high-dose groups were not statistically significant. Although the hyperlipidemic rat model was selected to evaluate potential anti-hyperlipidemic benefits of the slimming teas in a population-relevant metabolic context, no statistically significant improvements in lipid profile parameters were observed compared to the HFD-C group (Table 3). This lack of effect, despite trends in some high-dose groups, indicates that the tested teas did not demonstrate meaningful hypolipidemic activity at the doses and duration studied. These findings contrast with some literature on green/Pu-erh teas but align with the need for caution when relying on unverified commercial slimming products for metabolic benefits.

The hyperlipidemic model used here is clinically relevant, as many consumers of slimming teas have underlying dyslipidemia. However, the relatively short duration and small sample size per group (n=6) limit detection of subtle effects, as reflected in the low post-hoc power.

CONCLUSION

The two commercially available slimming teas produced only modest, mostly non-significant effects on lipid profile and antioxidant status in high-fat diet-induced hyperlipidemic female rats. While modest increases in glutathione were noted at lower doses, the absence of significant changes in malondialdehyde and key antioxidant enzymes (SOD, CAT, GPx, GST) indicates that oxidative stress was not a prominent mechanism of toxicity under the tested conditions. Similarly, no significant improvement in lipid profiles was observed, despite the marketed slimming and fat-reducing claims of these products.

These findings underscore the need for caution regarding efficacy claims and emphasize the importance of rigorous quality control and further well-powered studies before recommending widespread use.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author.

AUTHORS CONTRIBUTION

Conceptualization: I.R.D., T.-B.O.-I.; Methodology: I.R.D., B.C.L., C.U.G.-B.; Validation: S.K.E., I.A.-A.; Formal Analysis: U.F.E., N.C.C.; Investigation: All authors; Resources: T.-B.O.-I.; Data Curation: I.R.D.; Writing—Original Draft: I.R.D.; Writing—Review & Editing: All authors; Supervision: I.R.D.; Project Administration: T.-B.O.-I.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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