

Introduction

Valorization of grape pomace (GP) waste represents an important strategy for addressing both environmental and economic challenges associated with the wine industry. By transforming this abundant by-product into valuable products, GP valorization contributes to reducing environmental pollution while promoting resource efficiency within a circular economy framework (Fontana et al (2013); Karastergiou et al (2024)). The present study aimed to investigate the effects of WGP extract administration on oxidative stress parameters and lipid metabolism, specifically total cholesterol and triglyceride levels, in a rat model of diet-induced dyslipidemia.

Materials and methods

Animal model: Forty adult male Wistar rats (200–250 g) were used in the study and maintained under controlled laboratory conditions (22 ± 2 °C, 50–60% humidity, 12 h light/dark cycle) with free access to food and water. After one week of acclimatization, animals were randomly divided into five experimental groups (n = 8 rats per group) (Figure 1).

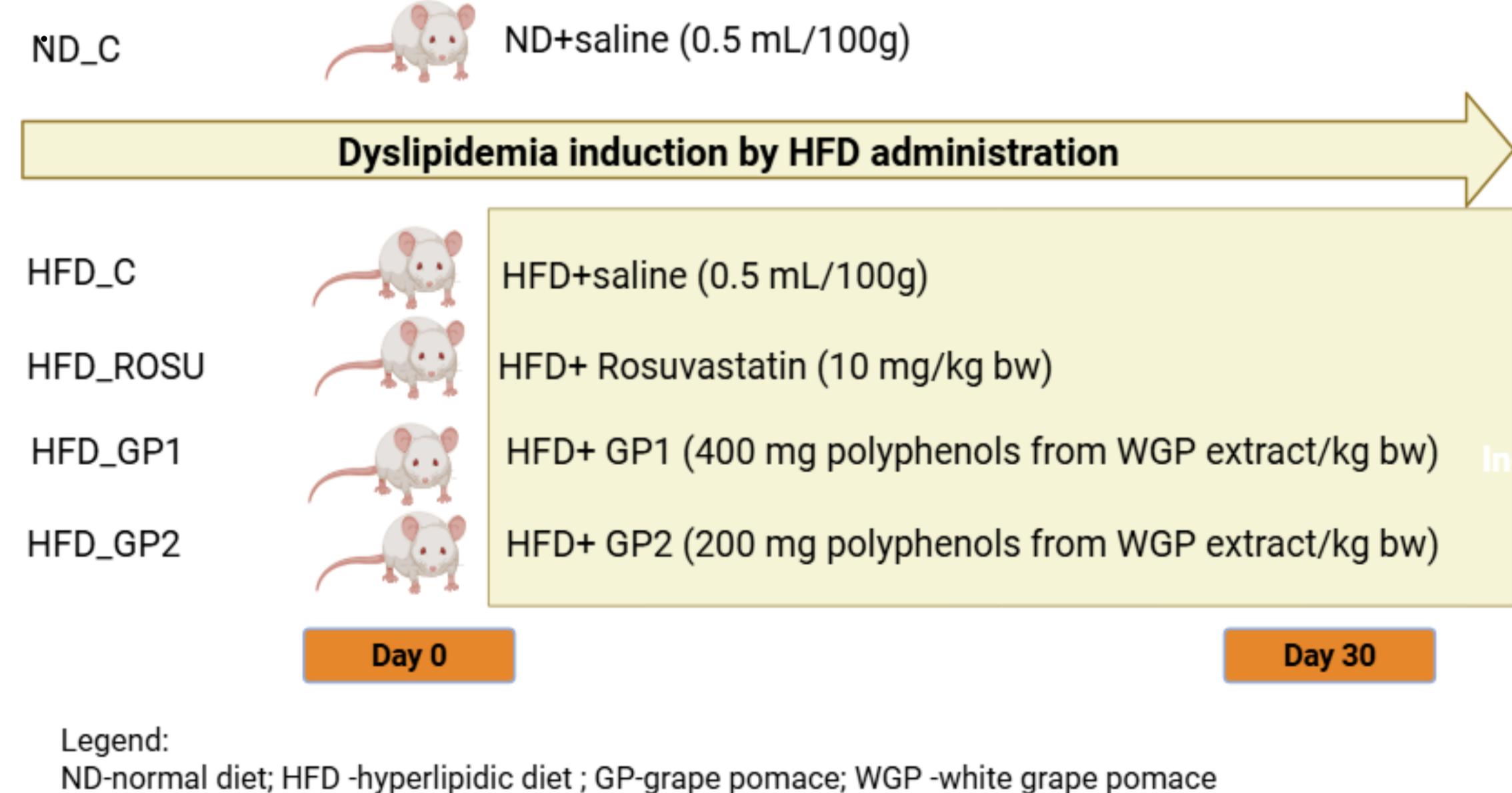


Figure 1. Experimental design of induced dyslipidemia in rats

Oxidative stress and biochemical analysis: Total cholesterol and triglycerides were determined using enzymatic colorimetric methods, while oxidative stress markers, including malondialdehyde (MDA), total oxidative status (TOS), nitric oxide (NO), total antioxidant capacity (TAC), total thiols, and oxidative stress index (OSI) were assessed using spectrophotometric assays.

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Results

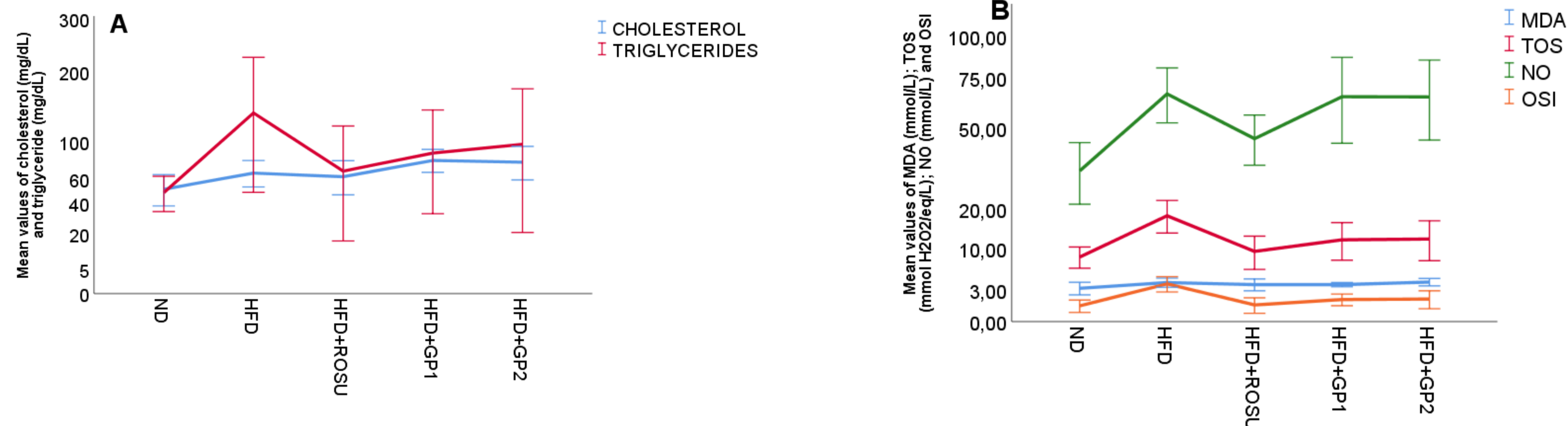


Figure 2. Serum concentration of cholesterol and triglycerides (A) and malondialdehyde (MDA), Total Oxidative Stress (TOS), nitric oxide (NO), and oxidative stress index (OSI) (B), in rats fed with a hyperlipidic diet.

- Total cholesterol levels were significantly higher in the HFD group compared with the ND group ($p = 0.006$), confirming the successful induction of dyslipidemia.
- No significant reduction in cholesterol levels was observed in the HFD+ROSU or HFD+GP2 groups when compared with the HFD group ($p > 0.05$).
- The HFD+GP1 group showed significantly higher cholesterol values compared with the HFD group ($p = 0.023$).
- Triglyceride levels were markedly increased in the HFD group compared with the ND group ($p < 0.001$).
- Treatment with rosuvastatin significantly reduced triglyceride levels compared with the HFD group ($p = 0.0025$), while the reductions observed in the GP1 ($p=0.051$) and GP2 groups did not reach statistical significance, although a decreasing trend was noted.

Conclusions

These findings support the potential of waste GP valorization as a sustainable source of bioactive compounds with antioxidant activity, capable of mitigating oxidative stress associated with dyslipidemia, although its lipid-lowering effect appears limited compared with rosuvastatin under the present experimental conditions.

- The HFD group exhibited significantly higher MDA values compared with the ND group ($p = 0.001$), confirming enhanced lipid peroxidation following high-fat feeding.
- Similar significant difference was observed between the ND group and the HFD+GP2 group ($p < 0.001$).
- Comparisons between ND and HFD+ROSU as well as ND and HFD+GP1 were not statistically significant ($p > 0.05$), although both groups showed intermediate values.
- Total oxidative status (TOS) was significantly higher in the HFD group compared with the ND group ($p < 0.001$).
- Administration of rosuvastatin and WGP extracts significantly reduced TOS levels compared with the HFD group ($p < 0.001$).
- Total antioxidant capacity (TAC) was significantly increased in the HFD+ROSU, HFD+GP1, and HFD+GP2 groups compared with the HFD group ($p < 0.005$), indicating improved antioxidant defense.
- Oxidative stress index (OSI) was significantly reduced in the treatment groups compared with the HFD group, reflecting an overall improvement in the oxidative balance.

Acknowledgments:

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