

Hypocholesterolemic Effects of Pressed and Solvent-Extracted Fruit Seed Oils

Hui Ean Teh¹, Wallace Yokoyama², Zhongli Pan^{1,2}, Tara H. McHugh²

¹Department of Biological and Agricultural Engineering, University of California, Davis, CA 95616, USA

²Healthy Processed Foods Research Unit, Western Regional Research Center, USDA-ARS, CA 94710, USA

ABSTRACT

Heart disease causes 25% of mortalities in United States. Adequate unsaturated fat intakes could reduce the risk. The research objective was to investigate the effectiveness of mechanical-pressed and solvent-extracted grape, tomato, and pomegranate seed oils in lowering plasma and liver cholesterol using hamster models. In the fruit seed oil (FSO) diets, pressed and solvent-extracted seed oils were used to partially replace butter in the control (C) diet. The results showed that FSO diets significantly reduced blood triglycerides and low-density lipoproteins (LDL). The FSO diets did not improve total triglycerides profiles in liver, but they did slightly increase hepatic total cholesterols and cholesterol esters. No significant differences in lipid modulating properties were observed between solvent-extracted and pressed oils. Partial replacements of saturated fat in high-fat diets with tomato, pomegranate, and grape seed oils from both pressing and solvent extraction could effectively reduce triglyceride levels and improve HDL/LDL ratio in blood.

INTRODUCTION

Cardiovascular heart disease (CVD) is the leading cause of mortality and morbidity in the United States. Major risk factors of CVD include high blood pressure, high low-density lipoprotein cholesterol (LDL), and smoking. In contrast, high-density lipoprotein cholesterol (HDL) can inhibit lipid oxidation in LDL and facilitate LDL clearance from plasma. Thus, diets that can reduce LDL levels and promote HDL levels are highly recommended.

Positive effects of monounsaturated and polyunsaturated fatty acids in CVD prevention are well established. Tomato, grape, and pomegranate seed oils contain more than 75% unsaturated fatty acids. Incorporating these specialty fruit seed oils in daily diets could potentially improve cardiovascular health.

OBJECTIVES

- To study the efficacy of tomato, grape, pomegranate seed oils, and pomegranate defatted meals in reducing triglyceride and cholesterol levels using hamster models
- To compare nutritional properties between mechanical-pressed and solvent-extracted fruit seed oils

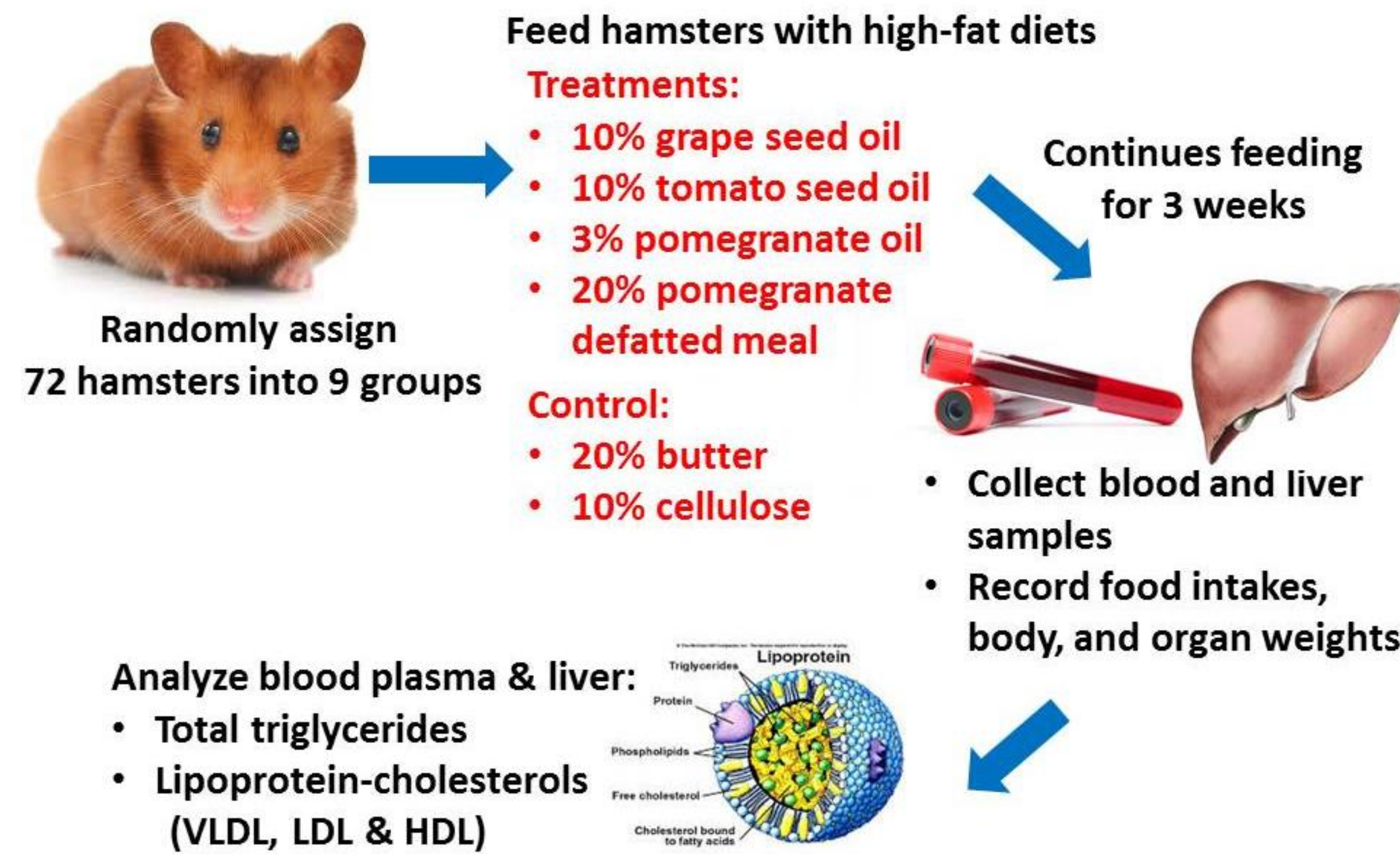


MATERIALS

Grape (GSO), tomato (TSO), pomegranate (PSO) seed oils and pomegranate defatted meals (PDM) were obtained from mechanical pressing and hexane extraction. Male Lakeview Golden Syrian hamsters with initial weights of 61-70g were used as animal models for the cholesterol studies.

METHODS

Experimental design



RESULTS & DISCUSSIONS

Body and organ weights

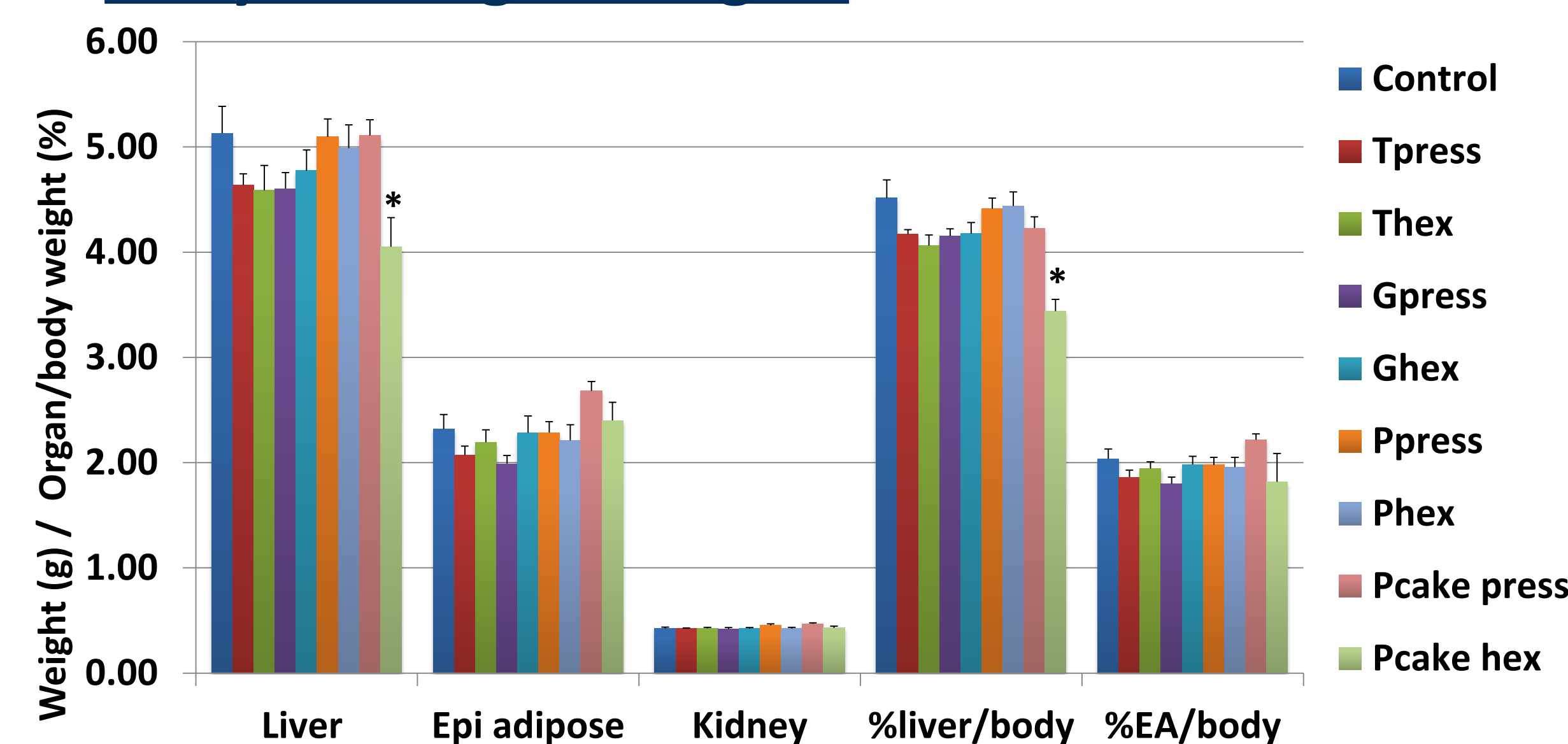


Figure 1. Organ weights

Total body mass gains of hamsters ranged from 34.8 to 43.8 g with no significant differences among the control and treatment groups. Liver, epidermis adipose, and kidney weights also did not vary significantly (Fig. 1). Thus, tomato, grape, and pomegranate seed oils did not impart toxicity effects when administered at 10%, 10%, and 3% (w/w).

RESULTS AND DISCUSSIONS

Plasma triglycerides and cholesterols

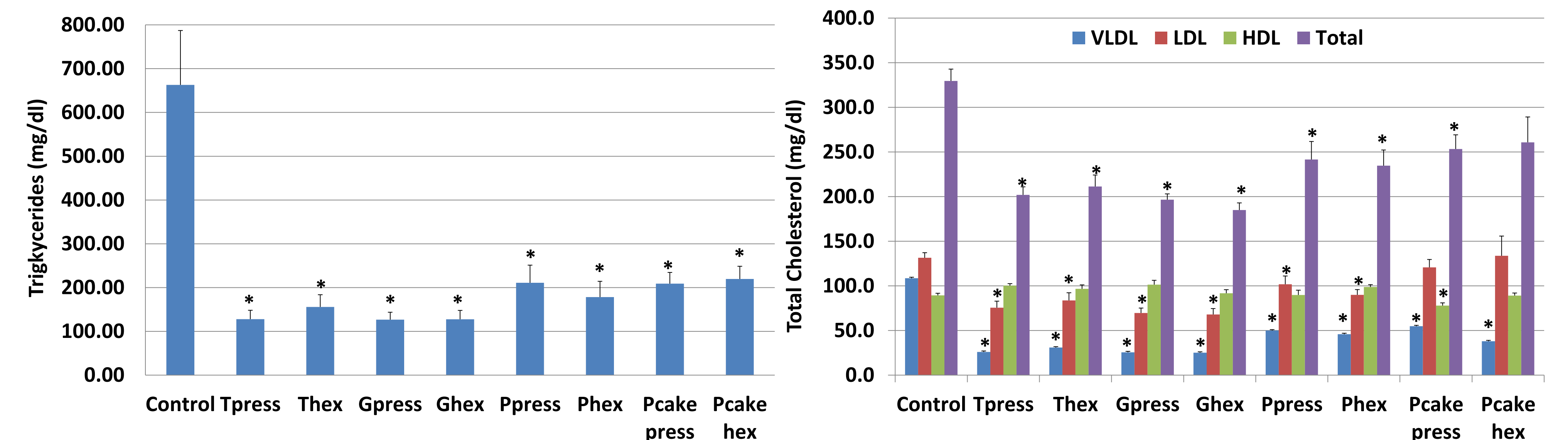


Figure 2. Total triglycerides in plasma

Figure 3. Cholesterol levels in plasma

Total triglycerides (TG) in plasma were significantly reduced in all treatment diets. No significant differences were observed in TG levels between mechanically-pressed and hexane-extracted oils (Fig. 2). Total, VLDL-, and LDL-cholesterol in FSO diets were significantly lower than the control (Fig. 3). The reductions were 2.2-4.3 folds for VLDL and 1.3-1.9 fold for LDL. Slight increases in HDL-cholesterol level for all FSO diets were also recorded. LDL/HDL ratios of all FSO diets, except pressed pomegranate oil, were lower than that of the control. Reduced LDL/HDL ratio should provide benefits of diminishing cardiovascular disease risk. For PDM treatments, only VLDL values were significantly reduced while LDL remained unchanged.

Liver triglycerides and cholesterols

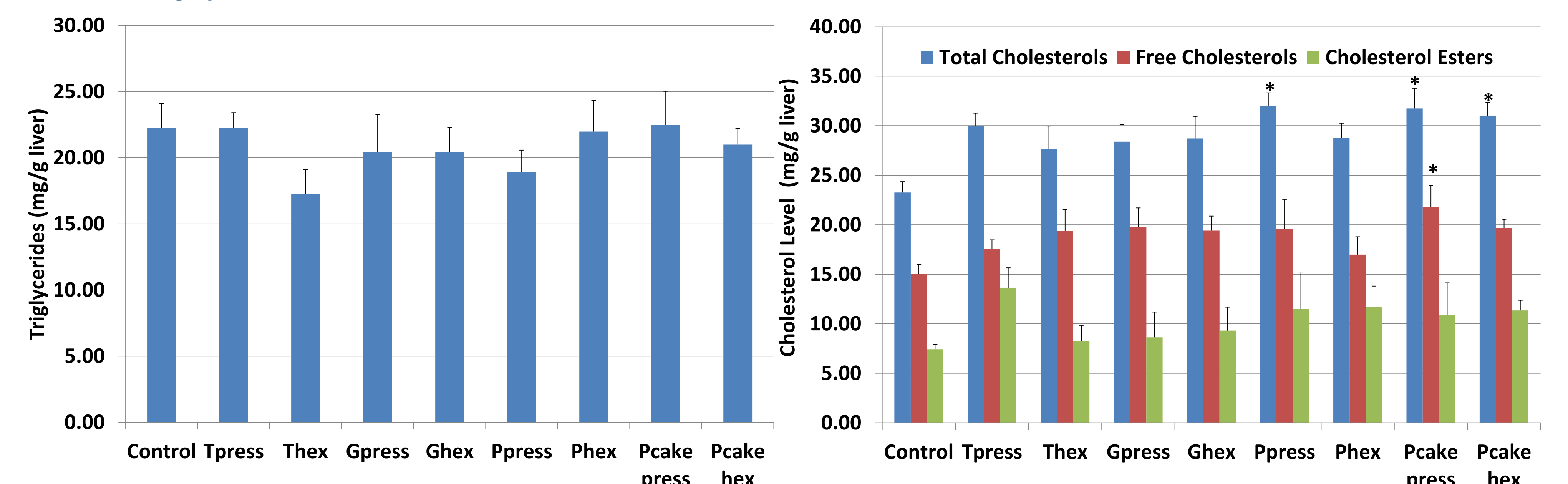


Figure 4. Total triglycerides in liver

Figure 5. Cholesterol levels in liver

Liver fat contents in the treatment groups were higher than those in the control. This suggested that fat transport from plasma into liver was enhanced in treatment diets. For hepatic total triglycerides, there were no significant differences among the control and FSO diets as well as between pressed and hexane-extracted oils (Fig. 4). Hepatic total cholesterols in all FSO were slightly higher than in the control (Fig. 5). Free cholesterol and cholesterol ester concentrations were elevated in all treatment diets, possibly due to activations of LDL uptake and lipid esterification by LDL-receptors in liver tissues.

CONCLUSIONS

Polyunsaturated fatty acid-rich tomato, grape, and pomegranate seed oils exhibited cardioprotective activity by reducing plasma LDL and LDL/HDL ratios, even when they were used as partial replacements for saturated fats. Oil extraction methods did not affect nutritional properties of the fruit seed oils. Consumption of these fruit seed oils as parts of a heart-healthy diet is highly recommended.

