



Combination of alcohol, fructose and lard diet to induce dyslipidemia and hepatic damage in a rodent model

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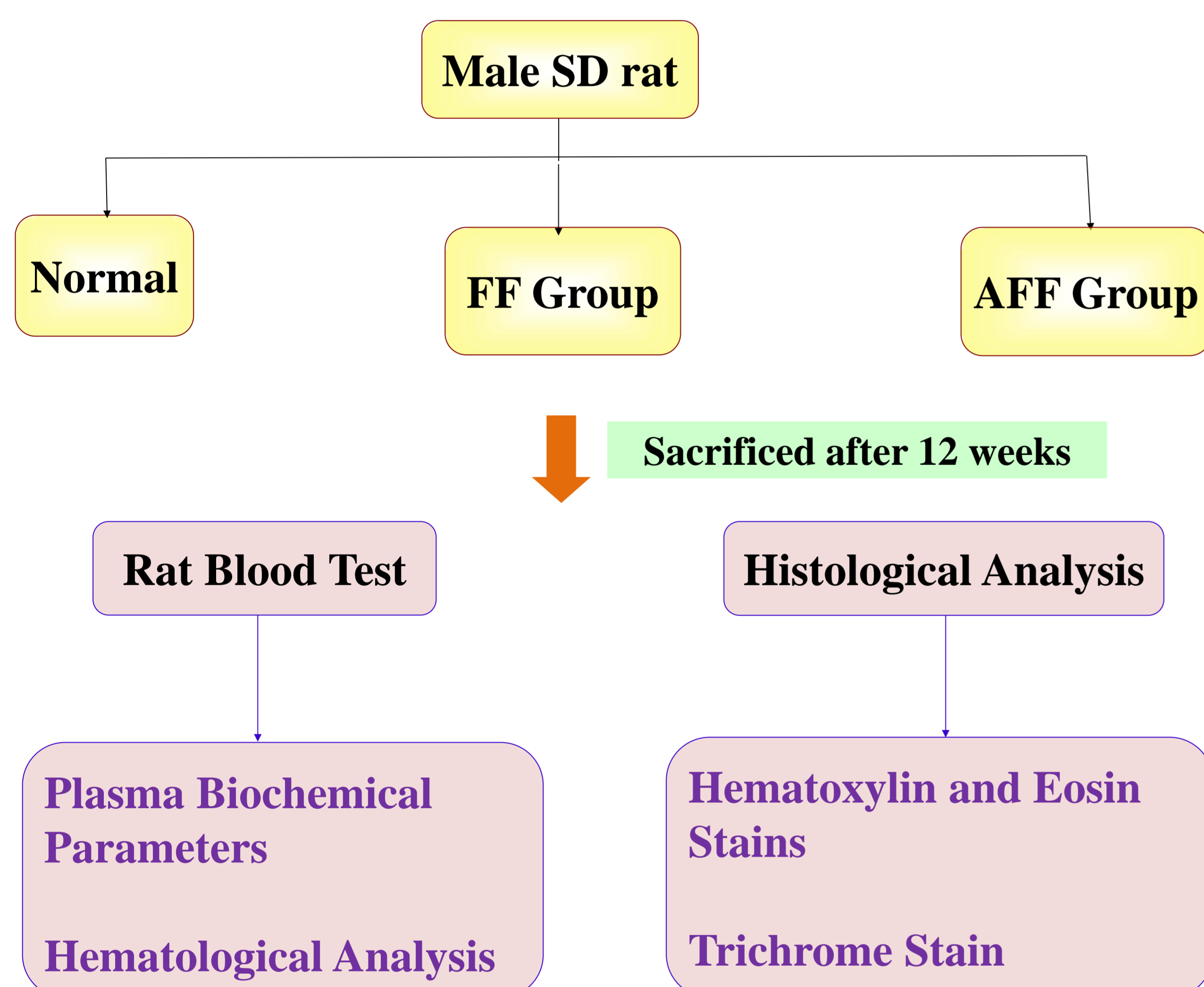
Abstract

Dietary intake of alcohol, fructose and fat are important factors in the pathogenesis of alcoholic fatty liver and alcoholic hepatitis. However, in vivo evaluation of high alcohol, fructose and fat diet in the development of hepatic inflammation have not been studied yet. To investigate whether chronic ethanol, fructose and fat intake can induce alcoholic liver injury in rats, the rats were divided into three groups: normal control group (basic diet), 30% fructose in drinking water plus 10% lard in basic diet group (FF) without or with 30% alcohol added in drinking water (AFF). Rats were fed ad libitum for twelve weeks then samples of serum and liver were collected for biochemical and histopathological examinations. Groups on an AFF diet showed reduced serum glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT) and blood urea nitrogen (BUN) levels compared to the control group. Pathologic changes in the histological sections (H&E staining) of hepatic tissue were also observed in AFF-fed rats resembling that of mild steatosis. The preliminary results above suggest that the combination of high alcohol, fructose and fat diet contributes to dyslipidemia-accompanied liver damage. We will further elucidate the mechanism ameliorating liver damage in high alcohol, fructose and fat diet rats.

Introduction

The Western-style diet usually involves a substantial amount of red meat or processed meat, sugary drinks, alcoholic beverages, sweets and refined carbohydrates or potatoes. It is linked to increased risk of liver disease, diabetes and other chronic conditions. Studies have shown that fructose can induce nonalcoholic fatty liver disease (NAFLD) in both humans and animals. However, the effect of alcohol consumption on NAFLD have not been studied in detail, in particular, the combination with (high) fructose and fat has not been investigated. The objective of this study is to develop, using multipurpose outbred rat, a rodent model of fatty liver disease based on nutritional compositions that reflects the Western-style diet. In this study, we evaluated the effects of selected nutrients, their relative contribution and interaction, and metabolic regulatory pathways in the development of hepatic damage.

Experimental structure and method



Results

Table 1. Plasma biochemical parameters of rats after given 12 weeks of different diet combinations.

Items	Normal	FF	AFF
Glucose (mg/dl)	177 ± 8.01 ^{ab}	148 ± 46.1 ^a	153 ± 47.5 ^b
Total cholesterol (mg/dl)	62.7 ± 5.44 ^{ab}	57.7 ± 1.84 ^a	51.2 ± 18.2 ^b
Blood urea nitrogen (mg/dl)	16.0 ± 0.82	11.0 ± 4.65	10.4 ± 3.83
Total bilirubin (mg/dl)	0.30 ± 0	0.23 ± 0.09	0.22 ± 0.08
Glutamate oxaloacetate transaminase (mg/dl)	41.3 ± 3.86	29.1 ± 12.0	27.2 ± 10.3
Glutamate pyruvate transaminase (mg/dl)	23.0 ± 0.82	Under 10	Under 10

Each value represents mean ± S.D. (n = 6). Normal: rats were fed with normal diet for 12 weeks, FF: 30% fructose in drinking water plus 10% lard in basic diet for 12 weeks, AFF: 30% alcohol and 30% fructose in drinking water plus 10% lard in basic diet for 12 week. (a,b) different letters signify statistically significant difference, (p < 0.05).

Table 2. Hematological parameters of rats after given 12 weeks of different diet combinations.

Items	Normal	FF	AFF
White blood cell (uL)	12.6 ± 3.56	12.1 ± 3.23	11.1 ± 3.24
Lymphocyte	9.10 ± 2.60	8.75 ± 2.40	8.07 ± 2.35
Monocyte	0.67 ± 0.31	0.57 ± 0.19	0.51 ± 0.18
Granulocyte	2.87 ± 0.85	2.74 ± 0.78	2.57 ± 0.83
Lymphocyte %	72.1 ± 1.74	66.2 ± 20.6	65.8 ± 19.3
Monocyte %	4.87 ± 1.85	4.07 ± 1.29	3.80 ± 1.16
Granulocyte %	23.0 ± 0.42	21.0 ± 6.93	21.2 ± 6.72
Hemoglobin (g/dL)	16.1 ± 0.36	14.3 ± 4.50	14.4 ± 4.24
Hematocrit (%)	41.8 ± 1.01	37.3 ± 11.7	37.4 ± 11.0
Red blood cell (uL)	8.61 ± 0.19	7.77 ± 2.44	7.76 ± 2.29
Mean corpuscular volume (fL)	48.6 ± 2.03	43.8 ± 13.3	43.7 ± 12.6
Mean corpuscular hemoglobin (pg)	18.7 ± 0.66	16.8 ± 5.13	16.8 ± 4.85
Mean corpuscular hemoglobin concentration (%)	38.5 ± 0.61	35.1 ± 10.9	34.9 ± 10.2
Red blood cell distribution width (%)	18.0 ± 0.23 ^b	17.1 ± 5.38 ^a	17.1 ± 5.01 ^a
Red blood cell distribution width	31.0 ± 1.70	28.8 ± 8.63	28.9 ± 8.28
Platelet (uL)	339 ± 121	277 ± 94.9	267 ± 92.1

Each value represents mean ± S.D. (n = 6). Normal: rats were fed with normal diet for 12 weeks, FF: 30% fructose in drinking water plus 10% lard in basic diet for 12 weeks, AFF: 30% alcohol and 30% fructose in drinking water plus 10% lard in basic diet for 12 week. (a,b) different letters signify statistically significant difference, (p < 0.05).

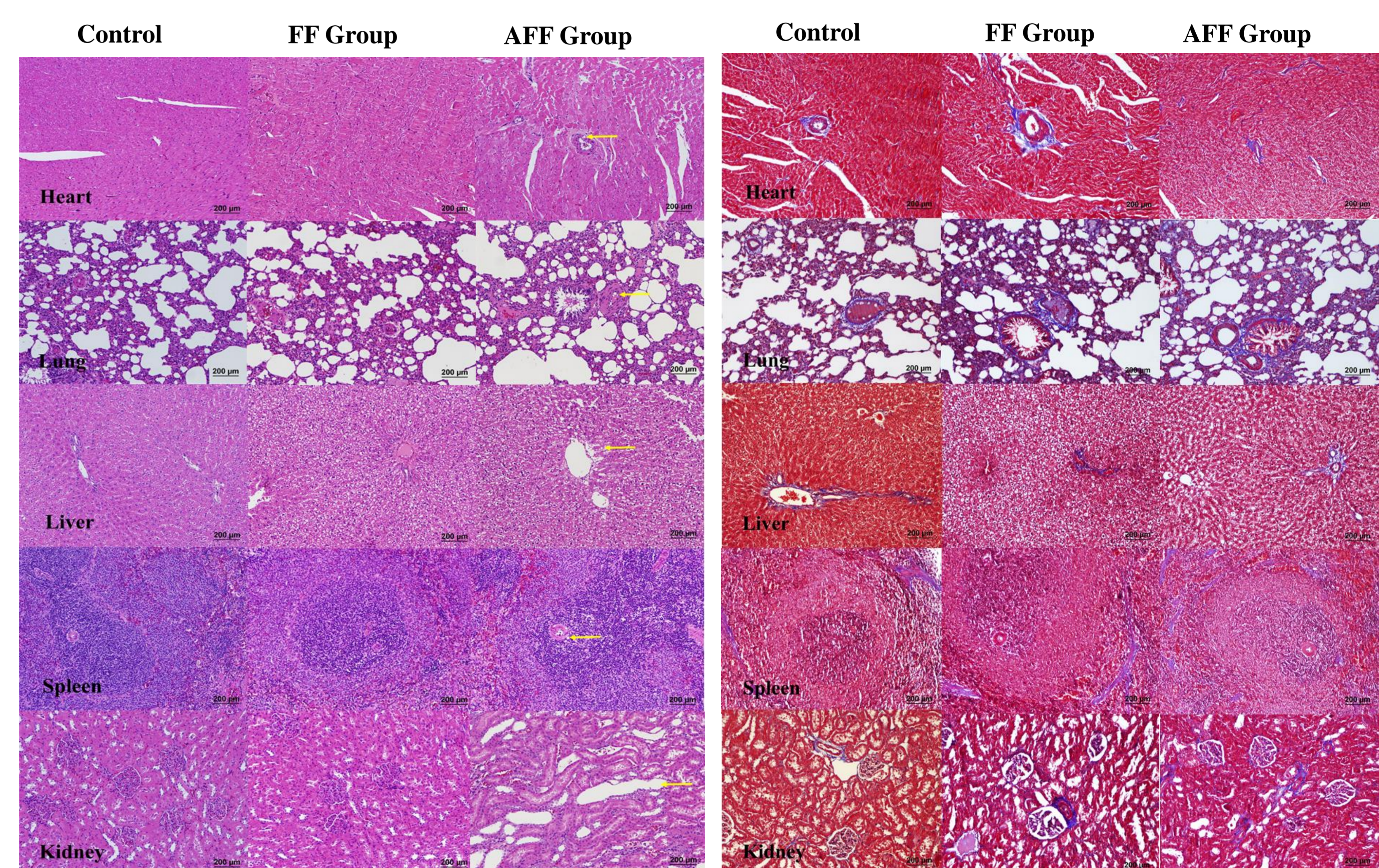


Figure 1. Histopathological changes in different organs of rats subjected to different treatments. (H&E stained, × 200) Fatty tissue is due to the deposition of fat, seen here as white droplets (yellow arrows).

Figure 2. Representative photomicrographs from each group after 12 weeks of experimental treatment. (Trichrome-stained organ sections, × 200).

Conclusion

The present study showed that the combination of alcohol, fructose and fat diet contributes to dyslipidemia-accompanied liver damage. This rat model may be useful in studying the pathogenesis of liver damage.