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# Effect of Senna and Radish Extracts on Hepatic Function in High Fat Diet Fed and Diabetic Rats

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## ABSTRACT

Hyperlipidaemia and diabetes are widely associated with liver injury. Senna and radish leaves have been reported to possess anti-diabetic, anti-oxidant, and anti-hyperlipidemic activities. However, there is not enough information of these herbal medicines on hepatic function of rats with metabolic disorders. Therefore, the objective of the current study was to screen herbal extracts of senna and radish leaves on hepatic function in high fat fed and diabetic rats.

Qualitative phytochemical investigation was done as per standard procedures. Quantitative phytochemical investigation was done using gravimetric method and HPLC analysis. Sprague–Dawley rats were fed on their respective diet (high fat/ normal pellet diet) for 16 weeks and thereafter, all the rats were divided into seven groups for high fat diet model and into eight groups for streptozotocin and high fat diet-induced diabetes model. Treatment duration was 07 weeks for high fat diet models and 03 weeks for diabetes model. Parameters studied in these models were body weight, food intake, alanine aminotransferase, aspartate aminotransferase, liver weight and liver histopathology. Qualitative phytochemical investigation revealed the presence of flavonoids, glycosides, tannins, carbohydrates and saponins, while quantitative analysis revealed presence of rutin and myricetin in radish extract and presence of sennoside and rutin in senna extract. Treatment groups showed significant decrease in body weight, food intake, alanine aminotransferase and aspartate aminotransferase. Significant improvement was observed in liver histopathology in extract treated groups. It is concluded that senna and radish leaf extracts significantly ameliorated liver function.

**Keywords:** Diabetes, High fat diet, Hepatic, Senna, Radish

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## INTRODUCTION

Diabetes and obesity are the most common cause of liver disease[1,2]. Hyperglycemia with insulin resistance in diabetes can destroy the hepatocytes[3,4], while in obesity excessive fat accumulation in the liver is associated with hepatic steatosis[5]. Hyperglycemia and hepatic steatosis can contribute to increased morbidity and mortality among patients of metabolic disorders [1,4].Hyperlipidemia, hyperglycemia, insulin resistance and oxidative stress contribute to the liver disease in the patients of metabolic disorders[6]. *Cassia angustifolia* (senna) is used traditionally as anti-inflammatory and in obesity[7], while *Raphanus sativus* (radish) is used for liver problems and in inflammation[8]. Both plants have been reported to possess anti-hyperlipidemic[9] and anti-oxidant[10,11] activities.

## MATERIAL AND METHOD

Aqueous extract of *Cassia angustifolia* (CAE) and hydroalcoholic extract of *Raphanus sativus* (RSE) was used in this study at the dose levels of 400 mg/kg and 800 mg/kg, orally. Qualitative phytochemical investigation was done as per standard procedures[12], while quantitative phytochemical investigation was done using gravimetric method[13] and HPLC analysis. Sprague–Dawley rats were fed on their respective diet (high fat/ normal pellet diet) for 16 weeks and thereafter, all the rats were divided into seven groups for high fat diet model and into eight groups for streptozotocin and high fat diet-induced diabetes model. Treatment duration was 07 weeks for high fat diet models and 03 weeks for diabetes model. Parameters studied in these models were body weight, weight gain, food intake, alanine aminotransferase (ALT), aspartate aminotransferase (AST), liver weight and liver histopathology [14,15].

## RESULT AND DISCUSSION

Qualitative phytochemical analysis of the extracts showed presence of flavonoids, glycosides, saponins and/or tannins. Quantitative analysis by gravimetric analysis, indicated presence of flavonoids: 5.2%, cardiac glycosides: <2%, saponins: 24.52% and tannins: 2.91% in RSE and glycoside:

2.62%, flavonoids: 4.62%, saponins: <2% in CAE. HPLC method, indicated presence of rutin: 0.12 % and myricetin: 0.03% in RSE and Sennoside A: 0.73 %, Sennoside B: 1.55%, and rutin: 0.15 % in CAE. Significant decrease in body weight and food intake was observed in extracts treated groups as compared to HFD group in high fat diet model (Table 1). Decreased body weight and food intake in extract treated groups are beneficial to reduce progression of liver disease associated with high fat diet intake. In high fat model, both RSE and CAE reduced AST level (Table 1). In diabetic rats, treatment with RSE reduced serum AST and ALT level (Table 2). Flavonoids, glycoside and saponins, present in both extracts, resulted in the amelioration of liver enzymes. Histopathology of liver in high fat fed model (Figure 1) revealed that a high degree of steatosis was developed in the HFD group, whereas no histological abnormalities were seen in the NPD group. Microvesicular steatosis was observed in all groups fed with HFD. Treatment groups showed regenerating hepatocytes, mild intracytoplasmic vacuolation and mild pigmentation. Significant decrease in microvesicular steatosis was observed in RSE4, RSE8, CAE4 and CAE8 groups as compared to the HFD group. Histopathology of liver in diabetes model (Figure 2) revealed that a high degree of steatosis and structural changes were developed in the HFD+STZ group. Steatosis was observed in all groups fed with the HFD. Congestion, vacuolation and cytoplsmic degeneration was observed in HFD+STZ group. Significant amelioration in structure and steatosis was observed in RSE4, RSE8, CAE4 and CAE8 groups as compared to the HFD+STZ group. All section showed vacuolation in periportal cell, congestion and RBCs except NPD and NPD+STZ group. RSE and CAE treatment significantly reduced excess fat deposition in the liver as indicated by liver histopathology.

**Table 1 Effect of senna and radish extracts on the study parameters in high fat diet model**

| Groups | Parameters | | | | | | |
|---|---|---|---|---|---|---|---|
| | Initial body weight (g) | Final body weight (g) | Body weight gain (g) | Food intake (g/rat/day) | AST (U/L) | ALT (U/L) | Relative organ weight % |
| NPD | 225.00±4.65 | 245.00 ± 5.77 | 20.00±1.83 | 10.37±0.09 | 139.14±12.72 | 36.61±3.25 | 2.78±0.19 |
| HFD | 272.50±7.04$^{z}$ | 323.33±7.60$^{z}$ | 50.83±4.73$^{z}$ | 10.61±0.08 | 338.62±30.83$^{z}$ | 43.33±3.45 | 2.93±0.19 |
| RSE (400 mg/kg, p.o.) | 273.33±7.26 | 293.33±7.49$^{a}$ | 20.00±4.47$^{c}$ | 10.31±0.01$^{a}$ | 191.19±13.86$^{c}$ | 40.18±4.88 | 2.58±0.13 |
| RSE8 (800 mg/kg, p.o.) | 275.00±7.30 | 286.67±6.15$^{b}$ | 11.67±5.58$^{c}$ | 10.20±0.05$^{b}$ | 371.19±44.13 | 41.88±3.24 | 2.82±0.13 |
| CAE4 (400 mg/kg, p.o.) | 263.33±5.73 | 295.00±5.77$^{b}$ | 31.67±1.67$^{a}$ | 10.27±0.08$^{a}$ | 167.67±7.12$^{c}$ | 57.28±7.28 | 3.15±0.17 |
| CAE8 (800 mg/kg, p.o.) | 265.00±2.89 | 291.67±5.27$^{c}$ | 26.67±3.07$^{b}$ | 10.28±0.03$^{a}$ | 213.55±13.67$^{b}$ | 76.41±9.22$^{b}$ | 3.45±0.15 |
| Atorvastatin, AT (10 mg/kg, p.o.) | 260.83±3.00 | 305.00±4.28 | 44.17±3.27 | 10.50±0.07 | 244.50±7.87 | 53.74±4.97 | 2.98±0.22 |

Values are expressed as Mean ± SEM (n= 6), analyzed by One way ANOVA followed by Bonferroni Test. $^{z}$denotes $P< 0.001$ vs. NPD, $^{a}$ denotes $P< 0.05$, $^{b}$denotes $P< 0.01$ and $^{c}$ denotes $P< 0.001$ vs. HFD.

**Table 2 Effect of senna and radish extracts on the study parameters in diabetes model**

| Groups | Parameters | | | | | | |
|---|---|---|---|---|---|---|---|
| | Initial body weight (g) | Final body weight (g) | Body weight gain (g) | Food intake (g/rat/day) | AST (U/L) | ALT (U/L) | Relative organ weight % |
| NPD | 221.67±8.63 | 233.33±8.82 | 11.67±1.67 | 9.59±0.04 | 148.83± 4.00 | 47.52±4.09 | 2.99±0.32 |
| NPD+STZ | 230.83±2.39 | 240.83±2.01 | 10.00±2.89 | 10.25±0.04 | 150.70± 8.77 | 51.47±1.67 | 3.44±0.12 |
| HFD+STZ | 245.00±3.16 | 265.00±3.42$^{x}$ | 20.00±1.83 | 19.90±0.13$^{z}$ | 188.35±11.87$^{y}$ | 59.67±2.13$^{x}$ | 3.55±0.10 |
| RSE4 (400 mg/kg, p.o.) | 242.50±2.50 | 259.17±5.97 | 16.67±4.22 | 19.62±0.18 | 144.59±5.62$^{b}$ | 46.22±0.94$^{b}$ | 3.59±0.32 |
| RSE8 (800 mg/kg, p.o.) | 245.00±3.42 | 271.67±5.73 | 26.67±3.07 | 21.11±0.25 | 132.48±7.68$^{c}$ | 45.62±1.54$^{b}$ | 3.18±0.22 |
| CAE4 (400 mg/kg, p.o.) | 244.17±8.51 | 266.67±8.63 | 22.50±2.50 | 20.14±0.69 | 199.54±5.08 | 60.48±2.72 | 3.11±0.24 |
| CAE8 (800 mg/kg, p.o.) | 243.33±7.60 | 263.33±7.38 | 20.00±1.83 | 19.98±0.18 | 186.53±5.48 | 62.68±2.19 | 3.36±0.12 |
| Metformin, MET (100 mg/kg, p.o.) | 239.17±4.73 | 255.00±5.48 | 15.83±2.01 | 18.38±0.09$^{b}$ | 135.16±5.52$^{c}$ | 46.76±1.53$^{b}$ | 3.39±0.50 |

Values are expressed as Mean ± SEM (n=6), analyzed by One way ANOVA followed by Bonferroni Test.

$^{x}$ denotes $P< 0.05$ and $^{z}$denotes $P< 0.001$ vs. NPD, $^{b}$denotes $P< 0.01$ and $^{c}$ denotes $P< 0.001$ vs. HFD+STZ.

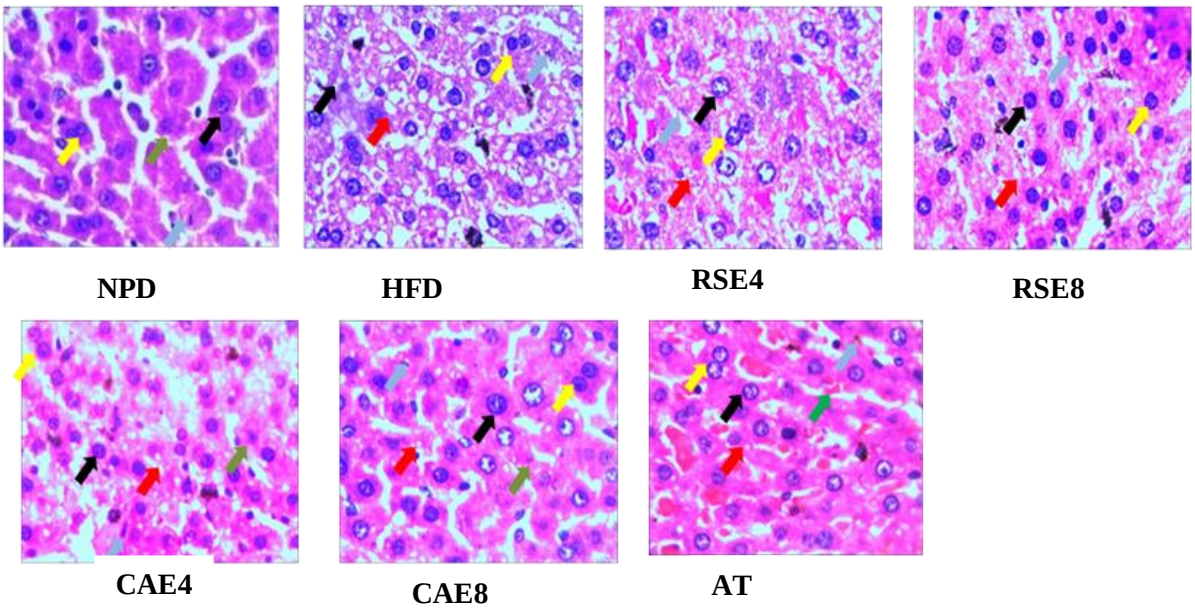


**Figure 1 Effect of senna and radish extracts on the histology of liver in high fat diet model** (H&E staining, 100× magnification, red arrow=fat depots, black arrow=nucleus, green arrow= congestion, yellow arrow=binucleated hepatocyte, blue arrow= mitotic figure

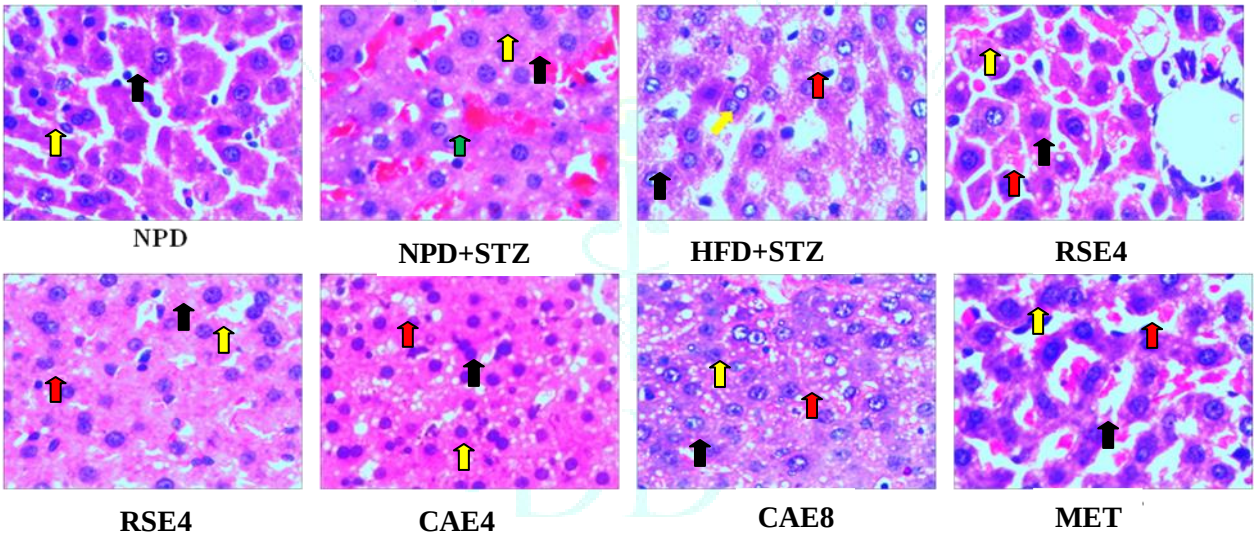


**Figure 2 Effect of senna and radish extracts on the histology of liver in diabetes model** (H&E staining, 100× magnification), red arrow =fat depots, black arrow=nucleus, green arrow= congestion, yellow arrow=binucleated hepatocytes

## CONCLUSION

It is concluded that leaf extracts of senna and radish significantly improved liver function, due to their antihyperlipidemic and antioxidant actions as well as presence of bioactive constituents like flavonoids, glycosides, saponins and tannins.

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## Conflicts of interest

Authors do not have any conflicts of interest.

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