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Effects of a crude Aloe vera leaf extract on diet-induced metabolic dysfunction in growing rats

Gasa, Zinhle Pearl

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ABSTRACT

The high prevalence of metabolic syndrome in children is mainly due to the adoption of an unhealthy diet and a sedentary lifestyle. The disorder is also associated with obesity, insulin resistance, hypertension and increased blood levels of triglycerides, free fatty acids and glucose. Although metabolic syndrome and its metabolic complications can be managed by the use of conventional medicines such as fenofibrate and metformin, there is a growing use of plants with medicinal properties. *Aloe vera* has been used for several medicinal purposes such as wound and burn healing, treatment of diabetes and treatment of cancer. *Aloe vera* also has biological activities that include anti-inflammatory, anti-microbial and laxative effects. Previous studies exploring the metabolic effects of *Aloe vera* have been in adult animals where metabolic syndrome was induced by the use of pharmacological agents. However, its beneficial effects in growing children who are at risk of developing metabolic syndrome have not been fully explored.

The objectives of this study were to evaluate the effects of a crude *Aloe vera* leaf extract on circulating metabolic substrates, the morphometry and morphology of the gastrointestinal tract and the liver function of growing rats.

Fifty-nine male Sprague-Dawley rats of 21 days old were randomly divided into one of six treatment groups. Group I (control) was fed normal rat chow (NRC) with plain gelatine cubes (vehicle). Group II received a high carbohydrate diet (HCD) with plain gelatine cubes; Group III received normal rat chow and fenofibrate at 100mg.kg^{-1}; Group IV received a HCD and fenofibrate at 100mg.kg^{-1}; Group V received a normal rat chow and *Aloe vera* at 300mg.kg^{-1};

Group VI received a HCD and *Aloe vera* at 300mg.kg^{-1}. The *Aloe vera* and fenofibrate were suspended in gelatine cubes and administered daily. After 20 weeks of feeding, the rats were fasted over night and an oral glucose tolerance test (OGTT) was performed. The rats were then euthanazed after 48 hours of re-feeding and tissues were collectedfor further analysis. The data was expressed as mean ± SEM and analyzed by a one-way ANOVA. A repeated measures ANOVA was used for statistical analysis of the data from the oral glucose tolerance test. The values were considered statistically significant when $p < 0.05$ followed by a Bonferroni *Post hoc* test.

After 20 weeks, the growing rats fed a high carbohydrate diet had a significantly higher body mass than the other groups ($p < 0.05$, ANOVA), however the administration of fenofibrate prevented the high carbohydrate-induced increase in body mass whilst *Aloe vera* was not effective. Linear growth as measured by the tibial length was not significantly different between the groups ($p >0.05$, ANOVA). There was no significant difference in the mass and relative density of the tibia bones of the rats between the groups. Feeding rats a HCD resulted in a higher ($p< 0.05$, ANOVA) visceral fat mass in the rats. Fenofibrate administration prevented the HCD-induced visceral fat mass gain whilst *Aloe vera* administration had no effect. Whilst the treatments did not result in any significant differences in the lengths and mass of the small intestine, the mass of the large intestine was significantly lower in the rats that received the HCD alone ($p < 0.05$, ANOVA). Fenofibrate administration resulted in a significantly increased liver mass compared to the other groups ($p < 0.05$, ANOVA). However there was no significant difference in the lipid and glycogen content in the liver.

Fasting concentrations of metabolic substrates (glucose, triglycerides and free fatty acids) were not significantly different between the groups and no significant differences were observed in the

circulating concentrations of insulin and the homeostasis model assessment of insulin resistance (HOMA-IR) (ANOVA; $p>0.05$). The OGTT did not show any abnormalities in the ability of the rats to handle a glucose load between the groups.

An indirect assessment of liver function was performed by measurements of the blood concentrations of alkaline phosphatase (ALP), total bilirubin (TBIL), alkaline transaminase (ALT) and gamma-glutamyl transferase (GGT). There were significantly increased ($p<0.05$) ALP levels in rats fed NRC + FENO compared to the others. TBIL levels were significantly lower in rats fed a NRC + *Av* ($p< 0.05$, ANOVA) however the TBIL levels were within the normal range. The alkaline transaminase (ALT) levels were not significantly different between the groups ($p < 0.05$, ANOVA) and GGT was not detectable in any of the groups.

Weaning rats onto a high carbohydrate diet and feeding them the diet for 20 weeks resulted in the development of visceral obesity without altering the glucose tolerance and metabolic substrates. The treatment with fenofibrate prevented the high carbohydrate diet-induced visceral adiposity however compared to fenofibrate, treatment with the *Aloe vera* leaf preparation was not significantly effective.