TECHNICAL WHITE PAPER

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Sugarcane Polyphenols and Obesity

The Global Obesity Epidemic

BACKGROUND SITUATION: OBESITY

Obesity is a complex, multifunctional and largely preventable disease. Around a third of the world's population are either obese or overweight as defined by BMI (Body Mass Index). If this trend continues, it is estimated that 38% of the world's population will be obese by 2030.

Obesity is defined as excess body weight for height with excess adiposity or body fatness, particularly around the visceral region, but also right throughout the body. Obesity is associated with metabolic chronic metabolic diseases such as type -2 diabetes, hypertension, several cancers and cardiovascular disease. It is also influenced by lifestyle, behavioural and environmental and generic factors. (Hruby, A., et al (2015), The Epidemiology of Obesity: A Big Picture, Pharmacoeconomics, Volume 33, 673-689).

It is well accepted that obesity and its complications pose a huge burden on the individual and health care systems worldwide.

Obesity occurs in humans as well as animals, particularly companion animals such as dogs and cats and is also linked to type-2 diabetes and other co-morbidities. (Tvarijonaviciute, A., et al (2019), Pets as Sentinels, Forecasters & Promotors of Human Health. Similarities, links and differences in obesity in humans and dogs, pp 143-173).

A recent review evaluates the effectiveness of natural polyphenolic compounds that are currently used for management of obesity while examining different mechanisms of anti-obesity action associated with the enzymes, energy expenditure, appetite suppression, adipocyte differentiation, lipid metabolism and gut microbiota by various natural polyphenols. It also critically evaluates the in vitro, animal and clinical experimental data that support the anti-obesity potential of natural polyphenols. The published literature indicates that natural phenolic compounds can be effectively utilized as food or fortified foods, to manage obesity. However, there is still a need for systematic and targeted clinical studies required. (Singh, M., et al (2020), Future Foods 1-2, 100002, Managing Obesity through Natural Polyphenols. A Review)

A Recent TPM Bioactive Division Publication

Polyphenol Rich Sugarcane Extract Reduces Body Weight in C57/BL6J Mice Fed a High Fat, High Carbohydrate Diet

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Abstract: Energy-dense diets have been implicated as a driving force in the global obesity crisis. Sucrose derived from sugar cane (Saccharum officinarum) is a carbohydrate source at the centre of this discussion. However, sugar cane is a complex plant containing a wide variety of phytochemicals that may have anti-obesity properties. The objective of this study was to assess if polyphenols extracted from sugar cane were capable of mitigating the progression of diet-induced obesity. Methods: Forty-five male, six-week-old C57BL/6J mice were divided into groups of 15 and fed a high-fat, high-carbohydrate diet supplemented with 0%, 2% or 4% polyphenol-rich sugarcane extract (PRSE) for twelve weeks. Body weight, food intake, water intake and faecal content were measured in addition to dual energy x-ray absorptiometry (DEXA) of the mice. Gene expression was also assessed for a range of key metabolic pathways in both blood and tissue samples in order to determine PRSE's potential mechanisms of action. Data was analysed using ANOVA and post-hoc statistical methods. Results: Mice fed 4% PRSE were found to have a significantly lower overall bodyweight and adipose tissue accumulation compared to control (0%). This finding was supported by a reduced plasma leptin concentration and an increased excretion of carbohydrates. Upregulated gene transcriptions of adiponectin, PPAR, PPAR, UCP2 and fatty acid synthase mRNAs were also observed. Conclusions: These results indicate that reduced carbohydrate absorption is the primary mechanism leading to the reduction of body weight in mice fed a high-fat, high-carbohydrate diet. This is predominately supported by the detection of increased carbohydrate concentration in the faeces of mice that lost weight. Other potential mechanisms, such as feed intake and energy expenditure, did not show significant differences between groups and are less likely to be involved.

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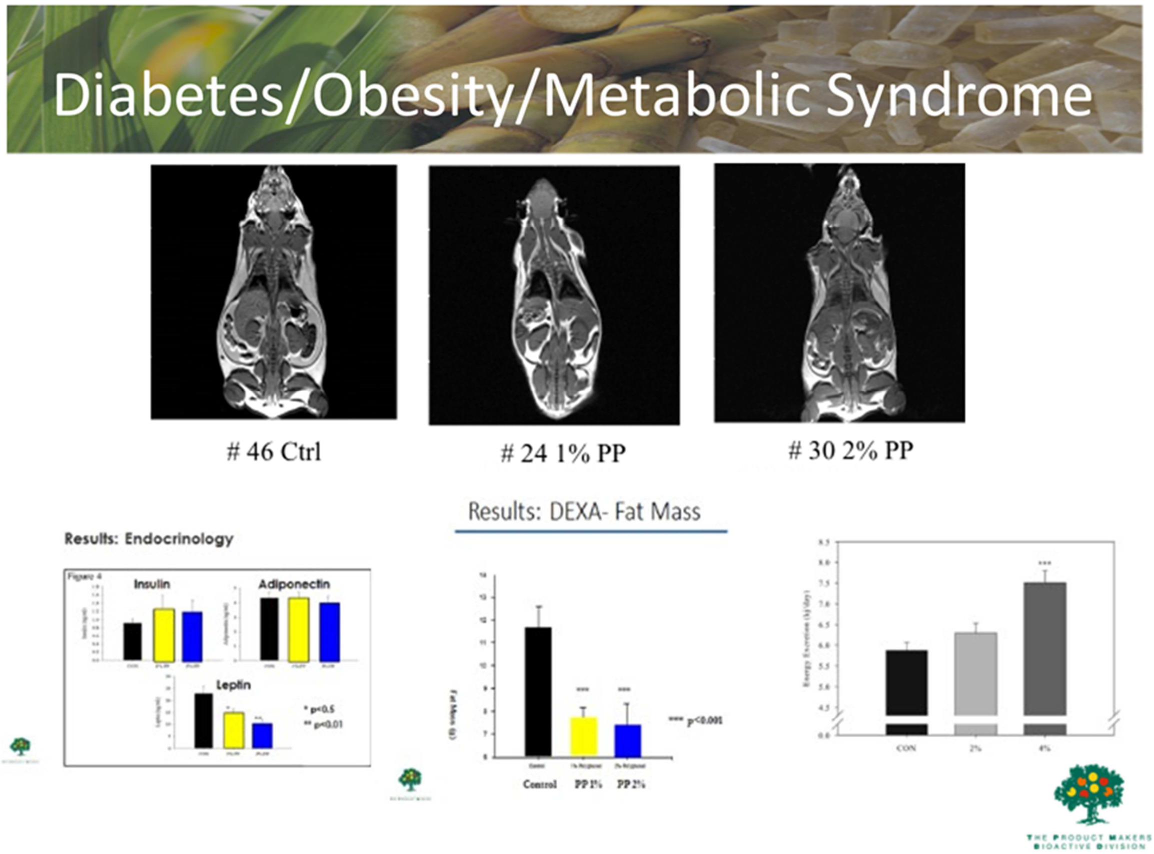
Earlier Publications



MOLASSES EXTRACT DECREASES DIET-INDUCED OBESITY

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INTRODUCTION

Obesity is a major health problem and is associated with more than 30 medical conditions including hypertension, heart disease, and type 2 diabetes (Kopelman 2000; Friedman 2000). The mechanisms controlling body weight in humans are complex and include genetic, physiological, and behavioural factors. An important factors in the development of obesity is the high intake of energy-dense, micronutrient-poor processed foods (Swinburn 2004).

Recent research suggests that polyphenols, a class of plant metabolite characterised by aromatic rings and hydroxy groups, have powerful antioxidant properties and numerous potential health benefits (Kao 2006; Manach 2004; Williamson 2005). Extensive processing of food and many of the current agricultural practices, however, reduce the polyphenol content of foods (Kalt 2005; Asami 2003).

Molasses has high levels of hydroxycinnamic (caffeic, ferulic and chlorogenic acids), benzoic acids (protocatechuic and hydroxybenzoic acids) and flavonoid polyphenols but little, if any, catechins and no caffeine (Payet 2006).

The aim of the present study was to consider the influence of molasses-derived polyphenols on diet-induced obesity.

METHODS

Male C57BL/6J mice (6 week old) were fed a high fat (21%) diet for 12 weeks to induce obesity

The diets contained 0 (CONTROL, n=15), 2 (n=15) or 4% (n=15) of molasses extract (ME); The energy content of the diets was 21.5, 21.0 and 20.9 MJ/kg, respectively for the three diets.

Body weight, food and water intakes were measured daily

Faeces was collected in week 8 and energy content was determined using bomb calorimetry; digestibility (%)=100 x (total energy intake-total energy excreted)/(total energy intake); where total energy intake =diet energy x total food intake; total energy excretion=faecal energy x total faecal excretion.

Glucose tolerance test was performed in week 10.

Dual energy X-ray absorptiometry (DEXA) scanning was performed after 10 weeks treatment to determine body composition

At the end of the 12 week period, plasma adiponectin and leptin (ELISA), adipose (adiponectin, PPARγ2, FAS) and liver (PPARα, FAS, PGC1α, UCP2) mRNA expression were determined

REFERENCES

Kopelman, Nature 2000, 404, 635; Friedman, Nature 2000, 404, 632; Swinburn, Public Health Nutr 2004, 7, 123; Kao, Molec Nutr Food Res 2006, 50, 188; Manach, Am J Clin Nutr 2004, 79, 727; Williamson, Am J Clin Nutr 2005, 81 (Suppl), 243S; Kalt, J Food Sci 2005, 70, R11; Asami, J Agri Food Chem 2003, 51, 1237; Payet, J Agri Food Chem 2006, 54, 7270.

ACKNOWLEDGEMENTS

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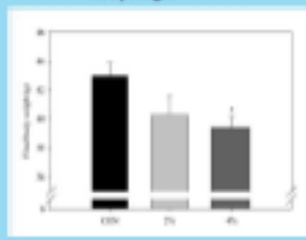
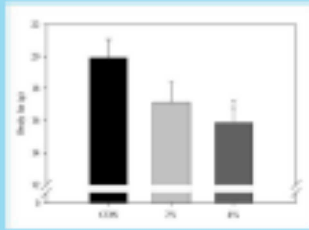
RESULTS

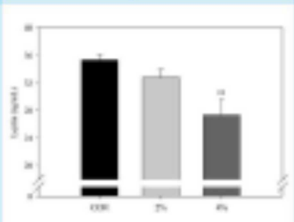
Body weight



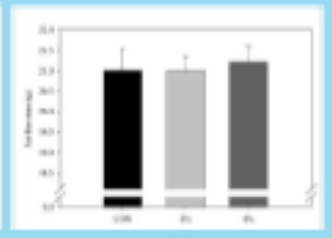
Fat Mass



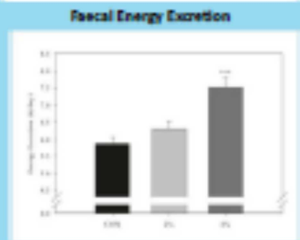
Leptin



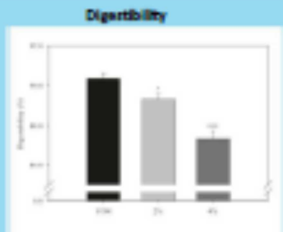
Fat Free Mass



Faecal Energy Excretion



Digestibility



SUMMARY of RESULTS

Addition of molasses extract to a high fat diet:

•decreased body weight, body fat, digestibility, and leptin;

•increased faecal energy excretion;

•did not alter food intake, bone mineral density, bone mineral content, glucose tolerance or adiponectin (data not shown) and fat-free mass (shown above);

• Gene changes: adipose (adiponectin ↑, PPARγ2 ↑, FAS ↑);
liver (PPARα ↑, FAS ↑, PGC1α↔, UCP2 ↑)

CONCLUSION

In conclusion, the addition of molasses derived polyphenols to a high fat diet reduced diet-induced obesity, primarily via mechanisms that include increased energy excretion, suggesting their potential use as supplements to ameliorate current trends in overweight and obesity. Further work is required to understand the contribution of the observed gene changes.

Sugarcane-derived polyphenols decrease diet-induced obesity

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Polyphenols are plant metabolites characterized by aromatic rings and hydroxy groups. Sugarcane contains a unique mix of antioxidant polyphenols such as hydroxycinnamic and benzoic acids. Our aim was to investigate the effect of sugarcane-derived polyphenols (SDP) on diet-induced obesity. Male C57BL/6J mice were divided into control (CON) or experimental groups, n = 12 mice/group. All groups were fed a high fat (21%) diet for 16 weeks; the experimental groups were supplemented with 200 or 400 mg/100 g diet, SDP200 or SDP400. Body weight, food and water intakes, body composition (DEXA); energy expenditure (indirect calorimetry), energy content of faeces (bomb calorimetry); glucose clearance and insulin sensitivity (following glucose load) were determined. The results indicated that relative to CON, food intake was decreased and fluid intakes were increased during the experimental period. Body weight was decreased by 15% (SDP200) and 30% (SDP400). Adipose tissue mass was decreased in both SDP groups, and fat-free mass was increased in the SDP400 group. Compared to CON, animals in both SDP groups had increased energy expenditure and increased faecal energy content. Animals in the SDP400 group had increased glucose clearance and insulin sensitivity. In conclusion, the addition of SDP to a high-fat diet reduced diet-induced obesity, possibly via mechanisms that include decreased energy intake, increased energy expenditure, and increased energy excretion, suggesting their potential use as supplements to ameliorate current trends in overweight and obesity.

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