# **ROLE OF ADZUKI BEAN EXTRACT ON OBESITY-ASSOCIATED METABOLIC DISORDERS**

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#### Introduction

- $\square$  > A potentially rich source of natural anti-obesity agents is the adzuki bean (*Vigna angularis*), which are often boiled to produce sweetened adzuki bean paste. This results in the release of several bioactive ingredients such as **polyphenols** and **fibers**, which have traditionally been discarded.
  - > To exploit these underutilized materials, "adzuki bean extract" has been developed (Cosmo Foods Co., Ltd., Tokyo, Japan).
  - > In this study, efficacy of the adzuki bean extract in the areas of **lipid metabolism** and obesity-associated disorders are evaluated both in vivo and in vitro.



## **Experiment 2 – Cell line study**

#### Cell culture and analysis

Human preadipocytes were cultured with adzuki bean extract at different concentrations (0, 250, 500 and 750 µg/ml).



- Quantification of TG accumulation in adipocyte cell lysates.
- •measurement of GPDH activity in adipocyte cell lysates.
- Determination of adipocytokine production in culture medium.

### Results

#### TG accumulation and GPDH activity







Hokkaido

#### Composition and stability

Adzuki bean extract contains polyphenols (<15%) such as catechin glucoside, anthocyanidins, and caffeic acid. It also contains micronutrients such as calcium, iron, magnesium and riboflavin as well as water-soluble fiber. Adzuki bean extract has high stability against temperature, pH and light.

#### **Experiment 1** – animal study **Animals and diets** Analysis Male F344 rat Body weight, food and water intake ①Control diet 1 Weights of organs <sup>(2)</sup>Control diet + 1% Adzuki bean extract and feces <sup>(3)</sup>High fat diet 4 weeks of (4)High fat diet + 1% Adzuki bean extract Feeding Serum, hepatic and period fecal lipid analysis Determination of

Control diet was prepared according to AIN-93G containing 5% soybean oil. High fat diet was prepared with 15% additional lard.

### Results

#### Hepatic and fecal weights and lipid concentrations

	Normal diet		High-fat diet		Group AF exhibited
Group	C	Α	CF	AF	ignificantly lower liver

250 500 750 µg/ml Control 250 500 750 µg/ml Control

Adzuki bean extract was able to suppress TG accumulation and GPDH activity. This study demonstrated that a dietary source of polyphenols shows important anti-obesity effects in human adipocytes.

#### Adipocytokines



Further experiments to elucidate whether adzuki bean extract had an effect on the regulation of proinflammatory cytokines in human adipocyte cells were very promising, with significant reductions compared to the controls for all treatment levels.



lipase inhibition

weight and total

PAI-1 I has been suggested that reduction of PAI-1 secretion could be resulted in attenuation of inflammation and vascular oxidative stress during the progression of hypertension. This PAI-1 reduction is observed in our study, suggesting that adzuki bean extract may attenuate progression of hypertension in addition to its anti-obesity effects.

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Weight (wet g/ bw)	2.17±0.06	2.16±0.02	$2.30 \pm 0.04$	2.12±0.03*	hepatic lipid content compared to group CF. Correspondingly, group AF had significantly
Total lipid (mg / liver)	64.4±3.86	66.5±6.66	142±27.4	75.9±10.8*	
Fecal matter					higher total fecal
Weight (wet g/ bw)	$1.40 \pm 0.10$	1.91±0.18*	$1.23 \pm 0.06$	1.89±0.15*1	weight and fecal lipid excretion compared with group CF.
Total lipid (mg / liver)	22.3±1.20	21.3±3.22	34.9±5.47	59.8±5.35*	

adzuki bean extract inhibits total lipid accumulation in the liver with a concomitant excretion of lipid into the feces, an effect that is especially apparent in rats fed a high-fat diet.

#### Serum lipid profiles



- >IL-6 is known to have direct effects on cellular metabolism, leading to hypertriglyceridemia by stimulating lipolysis and hepatic TG secretion. The reduced levels of IL-6 resulting from treatment with adzuki bean extract may explain the reduction in TG accumulation and GPDH activity observed in this study. In addition, mRNA expression of IL-6 was also reduced (data not shown), suggesting that the adipocyte inflammatory response system was attenuated by treatment with adzuki bean extract.
- MCP-1 A previous study reported that prolonged exposure to MCP-1 promoted insulin resistance in differentiated adipocytes and that levels of the MCP-1 protein was increased in obese mice. MCP-1 concentrations were significantly reduced by treatments with adzuki bean extract, indicating that this extract may help to prevent insulin resistance.

#### Conclusion

light.

Overall, the anti-obesity effects of adzuki bean extract demonstrated here make it a potentially important dietary supplement for the prevention and attenuation of obesity and related disorders. However, further research, including human studies to elucidate the mechanisms of action and the relative influence of different fractions of polyphenols contained in adzuki bean extract on biological functions is needed.

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The total cholesterol level, non-HDL-cholesterol and TG level were significantly lower in group A compared to group C. For the high-fat diet groups, non-HDL-cholesterol level was significantly reduced at 4 wks in group AF compared to group CF.

#### In vitro inhibition of pancreatic lipase activity by adzuki bean extract



Following the 70 min reaction time, the oleic acid concentration in the reaction mixture with adzuki bean extract was significantly lower compared to the mixture prepared without adzuki bean extract.

The anti-obesity adzuki bean extract observed in our animal study with regard to reducing serum TG and total hepatic lipid levels with concomitant lipid excretion are likely related to the ability of the polyphenols in adzuki bean extract to inhibit lipase activity.

The concentration of oleic acids released by lipase activity was determined at 37°C and pH 7.0 with an increasing reaction time in the presence and absence of 50  $\mu$ g/ml adzuki bean extract.

