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Efficacy of Slendesta® Potato Extract

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- *PI2, the active component in Slendesta Potato Extract 5% Powder, tested in a range of doses and forms, has been shown to induce satiety and/or associated weight management benefits in 11 clinical trials to date.*
- *When consumed as recommended, Slendesta Potato Extract 5% Powder has resulted in statistically significant weight loss and reductions in waist and hip measurements.*
- *Slendesta Potato Extract 5% Powder is thought to promote healthy weight loss through the stimulation of CCK release.*

INTRODUCTION

Worldwide obesity has more than doubled since 1980. In 2008 1,5 billion adults, 20 and older, were overweight and approximately 500 million were obese [1]. Weight management products and programs are constantly evolving. Many of these fail because dieters are unable to endure the commitment required to achieve their weight loss goals. Among the most common complaints of dieters is the constant feeling of hunger associated with reducing calorie intake. Because of this, Kemin has focused on providing a natural ingredient to help dieters feel satisfied over longer periods of time while eating smaller portions. This feeling, known as satiety, happens naturally through a complex series of events initiated by the consumption of food and ending with signals to the brain that fullness has occurred [2]. Foods are known to vary in their ability to stimulate satiety and one of the highest responses has been documented for potatoes [3].

Cholecystokinin CCK), the best-studied satiety factor, is a natural signaling peptide released by the gut in response to food [2, 4]. Once released, CCK acts on various target organs, resulting in signals to the brain, where it induces feelings of fullness and satiety. CCK cannot be consumed orally as it is degraded during the digestive process. A safe ingestible approach for dieters is needed.

Kemin has used patented technology to harness the CCK stimulating power of potatoes in Slendesta® Potato Extract (Slendesta). Slendesta is standardized to proteinase inhibitor II (PI2), a protein naturally present in potatoes. PI2 has been clinically shown to increase CCK release in humans which can help to increase feelings of fullness.

PI2 was discovered in the 1960's by Dr. Clarence Ryan of Washington State University. Study of the molecule throughout the 1970's and 1980's led to the discovery of many unique properties, among the most noteworthy of which was that feeding PI2 to animals, and later humans, resulted in an increase in the release of CCK [5]. This research is supported by several studies in the 1990's showing increased feelings of fullness, decreased food intake, and reduced post-meal blood sugar following PI2 consumption at levels ranging from 7.5 to 1000 mg [6-9]. To date, Kemin is aware of 15 clinical trials testing a range of doses and dosage forms that have been conducted looking at the effects of PI2 on plasma CCK levels, post-prandial glucose levels, hunger, satiety, and food intake and weight loss. Eleven of these studies showed statistically significant effects of PI2 on the tested study outcomes (**Summarized in Table 1**). Two trials fail to demonstrate the added benefit of PI2 over pre-defined interventions [10, 11] and two addressed the biological activity of the ingredient without reaching the statistical significance for the primary study outcome [12, 13].

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The effect of Slendesta on the subjective feelings of appetite and satiety were evaluated in a randomized, double-blind, placebo controlled, clinical study conducted at Iowa State University [14]. Forty five females took placebo, 15, and 30 mg PI2 (0, 300, and 600 mg Slendesta Potato Extract 5% Powder) in a cross-over design with one week intervals between treatments. In this study, the effect of Slendesta taken 60 minutes before a standard meal was significantly greater fullness, decreased motivation to eat and prospective food consumption, and reduced post-meal blood glucose levels compared to placebo. In addition, post-meal CCK levels were significantly increased and remained elevated longer, relative to placebo.

In a subsequent randomized, double-blind, placebo controlled, cross-over study [15] Slendesta, administered to 82 normal weight to overweight subjects at a 600mg dose (providing 30mg PI2) 60 minutes before an *ad-libitum* meal, significantly reduced subsequent food consumption by 13% relative to the placebo. This appetite suppressing effect was especially prevalent in middle aged and elderly subjects as well as in males.

In the largest randomized, double-blind, placebo controlled multi-site clinical study conducted with Slendesta [16], 240 participants consumed placebo, 15, or 30 mg PI2 (0, 300, or 600 mg Slendesta Potato Extract 5% Powder), 60 minutes before the two largest meals of the day for 12 weeks. Subjects taking Slendesta experienced statistically significant reductions in weight, waist, and hips from baseline relative to placebo.

In the longest study conducted for a total duration of 20 weeks [17] subjects took 15 to 30 mg PI2 (300 to 600 mg Slendesta Potato Extract 5% Powder) twice daily before the two largest meals. During this open-label study, subjects lost an average 2.7 Kg (0.6 lbs) per week and had statistically significant reductions in waist and hip measurements.

No adverse events associated with the administration of PI2 were detected among study participants

ADULT DAILY DOSAGE RECOMMENDATIONS

Before Meals:
Take 300 mg Slendesta Potato Extract 5% Powder (providing 15 mg PI2) with a full glass of water (if the product is provided in supplement form), approximately 60 minutes before the two largest meals of the day (an additional dosage may be taken if desired, for a total of 600 mg (30 mg PI2) before these meals).

Additional Directions:
The use of Slendesta does not replace of a healthy and controlled diet. Consult a physician before starting any weight management or exercise program. Pregnant or lactating women should consult their physician before using this or any product

CONCLUSION

CCK is a natural signaling peptide released by the gut in response to food and promotes satiety. Certain food components may be able to stimulate CCK release and this may be an explanation for the ability of potatoes to stimulate one of the highest satiety responses. Kemin has developed Slendesta in order to take advantage of the satiety induction mechanism of potatoes. Slendesta is a potato extract standardized to PI2 and manufactured using a patented process. Clinical trials indicate that Slendesta is a safe and effective natural ingredient that promotes CCK induced satiety and the reduction of food intake. When consumed as recommended. Slendesta has resulted in statistically significant weight loss and reductions in waist and hip measurements, and may be a useful aid in weight management

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Table 1. Summary of Trials Indicating Efficacy of PI2

STUDY AND SITE	DESIGN AND DURATION*	NUMBER OF SUBJECTS	PI2 DOSE	RESULTS
Hu, et al, 2011 [15] Effects of potato proteinase inhibitor II in promoting satiety and reducing food intake in healthy subjects. Des Moines University (DMU) Kemin Health White Paper (Proprietary data)	R, DB, PC, C 3 sessions: 6 hours; 1-wk intervals	82	30 mg in capusles; taken 60 minutes prior to an *ad-libitum* meal	13% reduction in food intake relative to placebo. The effect was especially prevalent among males as well as in middle-aged and older subjects. Some modulation of post-prandial desire to eat and prospective food consumption was also observed
Dana 2005 [17] A 20 week open- label clinical study shows Slendesta Potato Extract is effective for weight loss and improved body measurements Heartland Clinic Kemin Technical Literature (Proprietary data)	O 12/20 weeks	28/15	15 or 30 mg in capusles; taken 60 minutes prior to the two largest meals of the day	Significant reductions in weight, waist, hips, and waist to hip ratio from baseline ($p<0.001$). Average 0.27 kg/week (0.59 lbs/week) weight loss reduction over 20 weeks. The majority of subjects reported that the product made them feel full sooner, helped them feel full longer, made it easier to eat less and helped reduce between meals snacking throughout the study period. No serious adverse events associated with product use.
Dana 2005 [16] A randomized, double-blind, placebo-controlled clinical study demonstrates Slendesta Potato Extract is a safe and effective tool for promoting weight reduction. Research Test Laboratory (RTL) Kemin Technical Literature (Proprietary data)	R, DB, PC 12 weeks	240	15 or 30 mg in capusles; taken 60 minutes prior to the two largest meals of the day	Significantly greater reduction in body weight, compared to placebo at 12 weeks with 15mg (-0.57 Kg, $p=0.0734$) and 30 mg PI2 (-0.64, $p=0.0464$). Reduction in waist measurements observed with 15 mg and 30 mg PI2 dose. Reduction in hip measurements observed with 30 mg dose. Dose response effect observed. No significant reduction in weight or waist/ hip size in the placebo group. No serious adverse events associated with product use.
Hu et. al. 2004 [18] A randomized, double-blind, single-center study to evaluate the efficacy of a satiety aid I. Hill Top Research Kemin Technical Literature (Proprietary data)	R, DB, PC 6 weeks	83	15 or 30 mg in capusles; taken 30 minutes prior to lunch and dinner	Significant placebo subtracted weight loss (0.65 Kg (1.42 lbs), $p=0.0715$) with 30 mg PI2 ; waistline reduction vs baseline in the 15mg and 30 mg group; reduction in hip measurement vs baseline observed with 30mg; Over 60% of subjects lost weight (max 11.3 lbs, 5.1 kg). No serious adverse events associated with product use.
Dana et. al. 2005 [14] Slendesta Potato Extract promotes satiety in healthy human subjects: Iowa State University (ISU) Kemin Technical Literature (Proprietary data)	R, DB, PC, C 3 sessions: 4 hours, 1-wk intervals	45	15 or 30 mg in capusles; taken 60 minutes prior to a fixed meal	Consumption of 15 to 30 mg PI2 induced greater fullness, less motivation to eat than placebo. This effect was more pronounced at about 2 hours after the meal. In addition, a dose-response effect of PI2 was observed. PI2 consumption raised pre-meal CCK levels and sustained a higher post meal CCK levels for a longer period of time. Dose dependent decrease in post-prandial blood glucose was also observed. No serious adverse events associated with product use.

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STUDY AND SITE	DESIGN AND DURATION*	NUMBER OF SUBJECTS	PI2 DOSE	RESULTS
Spreadbury et. al. 2003 [19] A proteinase inhibitor extract from potatoes reduces post-prandial blood glucose in human subjects. Des Moines University JANA 2003; 6(1):29-38	R, DB, PC, C 2.5 hours	39	7.5, 15, or 30 mg in capsules , taken 30 minutes prior to a fixed meal	15 and 30 mg PI2 doses significantly reduced post-prandial blood glucose AUC relative to placebo by 29.8% and 24.5% respectively ($p<0.05$). A dose of 7.5 mg PI2 had no significant effect of blood glucose No adverse events related to PI2 consumption observed.
Vasselli *et al.* 1999 [9] Consumption of a pre-meal drink containing protease inhibitor from potatoes decreases hunger and increases fullness in overweight subjects following a meal.	R, DB, PC, C *3.5 hours*	24	30 mg as a pre-meal drink; 15 minutes before a fixed meal	Significant decrease in hunger ratings by 30% compared to placebo ($p<0.05$); Increased fullness ratings. No adverse events related to PI2 consumption observed
Spiegel *et al.* 1999 [8] Effect of a pre-meal beverage containing a protease inhibitor from potatoes on satiety in dieting overweight women.	*Mixed design* *4 weeks*	21	60 mg as a pre-meal drink 15 minutes before meal	Significant decrease in hunger ratings by 32% compared to placebo ($p<0.01$); Increased fullness ratings; Significant weight loss of 2 kg (4 lbs, $p<0.001$). No adverse events related to PI2 consumption observed.
Schwartz *et al.* 1994 [7] Treatment with an oral proteinase inhibitor slows gastric emptying and acutely reduces glucose and insulin levels after a liquid meal in Type II diabetic patients.	DB, PC, C *2 hours,* *1-wk intervals*	6 Type 2 diabetics	1000 mg in a glucose-protein shake	Significant increase in plasma CCK 15 min after PI2 consumed (1.5pmol/L, $p=0.05$) compared to placebo; Decreased blood glucose; decreased insulin; Delayed gastric emptying; ($p<0.05$). No adverse events related to PI2 consumption observed.
Hill *et al.* 1990 [6] Oral administration of proteinase inhibitor II from potatoes reduces energy intake in man. *Physiol Behav* 48: 241-246, 1990	R, DB, PC *1-wk intervals*	11	1000 mg in a high protein soup 5 minutes before an ad-libitum meal	PI2 combined with soup resulted in a significantly greater decrease in meal intake (17.5%, $p<0.02$) relative to soup alone (3%) and control. No adverse events related to PI2 consumption observed.
Peikin *et al.* 1987 and Peikin *et al* 1989 [20, 21] Oral administration of the protease inhibitor potato II stimulates release of cholecystokinin in man:	PC, C 1,5 hours	6	1000 mg as a meal drink, 15 minutes before an ad-libitum meal	PI2 consumption significantly increased CCK levels 15 minutes after dosing and then 30 minutes after the meal when compared to placebo ($p<0.05$). PI2 drink caused an 8% decrease in food intake compared to placebo (lactose) drink ($p<0.05$).

* R= Randomized; DB= Double-Blind; PC= Placebo Controlled, C= Cross-Over; O= Open-label

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