

# **The Effect of chlorogenic acid (Svetol™) and chlorogenic enriched coffee (CoffeeSLENDER®) on the glucose profile and bodyweight in healthy volunteers.**

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## **Introduction**

Coffee contains a variety of different substances of which several are biological active (1). The physiological effect of coffee is normally linked to the content of caffeine (2). Coffee contains, however, also a considerable amount of chlorogenic acid (CGA) (3), which belongs to the important group of biologically active phenols of which 5-caffeoylquinic acid (5-CQA) is the most important (4). Phenolic compounds are found in considerable amounts in the nature first of all in different plants (5).

The daily intake of CGA in persons drinking coffee is from 0.5 to 1.0 g (3,8). CGA has been shown to have antioxydative properties in laboratory experiments (7), and it is believed that the content of polyphenols in plants can be an important contribution to the cardio protective effect seen when using diets rich in fruits and vegetables.

Lately it has also been a considerable interest in investigating other properties than the antioxydative one (7), for such phenol compounds. Several new investigations indicate that some of the phenolic compounds found in certain food products can have an effect on the glucose absorption through different mechanisms of action (4).

The occurrence of diabetes 2 has shown an alarming increase during the last decade. This seems to be the case in all industrialised countries. In US it is estimated that around 8% of the population has diabetes 2. Diet and lifestyle are the main reason for this development. In addition to overweight and obesity other independent lifestyle parameters are of great importance such as physical inactivity, smoking, a diet with high glycemic index and trans fatty acid combined with a low content of fibre and poly unsaturated fatty acids. Worldwide it is estimated that 150 million people have diabetes 2 and WHO expect that this number will be doubled by 2025.

The intake of coffee might be linked to diabetes because metabolic short time studies indicate that caffeine can influence the insulin sensitivity and the glucose metabolism in a negative way. On the other side caffeine is stimulating the thermo genesis and increases the energy spending which can lead to a weight reduction. It is complicated to draw conclusions based on short time studies of caffeine because tolerance can develop when used long term. The intake of coffee is extensive. In US it is shown that more than 50% of the population is drinking coffee regularly and that the average consumption is 2 cups per day. In the Nordic area, especially in Finland and Norway, the consumption is estimated to be higher with approximately 4 cups per day. Coffee is the main source for caffeine.

During the later years a number of international epidemiological studies of high quality has been carried showing that coffee intake significantly reduces the risk for developing diabetes 2 in females and men (8 -12). The risk reduction can be substantial and shows a clear dose – response relation. However, it is not recommended at this stage to increase the consumption in order to counteract the development of diabetes 2.

The mechanism of action of coffee leading to a reduced risk for development of diabetes 2 is still not obvious. Much of the interest has been focused on the effect of caffeine. However, decaffeinated coffee seems to have the same risk reducing effect as normal coffee. In an English study published recently the focus has, however, been on chlorogenic acid and the effect of this organic acid on the glucose metabolism (4). Our international research project has been focused on chlorogenic acid. We have been interested in the effect of chlorogenic acid on the absorption of glucose as well as the effect of the acid on bodyweight, through a reduced glucose absorption, in healthy volunteers.

## **Methods**

The products tested have been put to our disposal by Med-Eq AS.Tønsberg, Norway and have been the following:

### **Svetol™**

Svetol™ is an extract of green coffee where the content of chlorogenic acid has been enriched. 45% of the content is chlorogenic acid. We have used capsules of 200mg meaning that each capsule contains 90mg chlorogenic acid.

### **COFFEESLENDER®**

CoffeeSLENDER® is an instant coffee product where each dose consist of 2000mg of instant coffee and 200mg Svetol™. We have used sachets of 2200mg in our studies with CoffeeSLENDER®.

We have carried out single dose studies to investigate the effect of Svetol™ and CoffeeSLENDER® on glucose absorption and compared it with the absorption after normal glucose loading studies as well as studies giving the products daily for a more extended time period. In the following we have listed and discussed the different studies:

### **Study I**

The study was carried out as an open study with 15 healthy volunteers. The objectives were to investigate the effect of Svetol™ on the glucose profile and also to investigate the effect on bodyweight after six weeks intake of the product. The daily dose was 3 capsules, 1 in the morning, 1 capsule at lunch and 1 capsule in the evening. No special diet was used and no advices about physical activity were given.

The glucose loading part of the study was carried out following an 8 hours fast. The participant received 18 jelly beans after the fasting glucose concentration had been measured. Measurements of the blood sugar were repeated 1 hour after intake.

In the second phase of the study (also after a fast of 8 hours) the participants received

### **Study II**

This study was carried out as a randomized placebo controlled double-blind study with 50 participants. 30 of them received Svetol™ and 20 received placebo capsules. All of the participants were given a diet plan. The Svetol™ dose was 2 capsules per day. The duration of the study was 8 weeks. The objectives of the study were to investigate the effect intake of Svetol™ might have on the body weight.

### **Study III**

The study was carried out in order to investigate if the intake of CoffeeSLENDER® had an effect on the glucose profile in healthy volunteers. The study was carried out in 6 persons. After an overnight fast (12 hours) the participants received a solution of 25 g sugar in 400 ml water. The blood glucose was measured in the fasting state and then 15, 30,45,60,90 and

120 minutes after intake. Following a wash-out period of 1 week the procedure was repeated. The participants then received after 12 hours fast a solution of 25 g sugar and 10g CoffeeSLENDER® in 400 ml water. Blood sugar was measured in the fasting state and then 15, 30, 45, 60, 90 and 120 minutes. The same procedures were repeated with 10g normal instant coffee (Nestle) and 10 g decaffeinated instant coffee (Nestle).

#### **Study IV**

The study was carried out as an open study in order to investigate the effect of CoffeeSLENDER® on body weight after a daily intake for three months. Fifty persons of both genders aged 18 –65 years with slight to moderate overweight participated in the study (BMI in the range 25.0 to 30. 0 kg/m<sup>2</sup>)

### **Results**

#### **Study I**

The objectives of the study were to investigate the effect of single doses of Svetol™ on the glucoseprofil as well as the long-term effect on bodyweight. A comparison of the blood sugar values with and without Svetol™ shows that the glucose absorption is reduced significantly after a single dose of Svetol™. The reduction in absorption is reduced by approximately 20% when the glucose values are compared one hour after intake with and without Svetol™. The values are as follows: Glucose intake without Svetol™ Initial value: 5.7 mmol/l, after 1 hour: 8.2 mmol/l. Glucose intake with Svetol™: Initial value: 5.4 mmol/l, after 1 hour: 7.4 mmol/l. The difference is significantly different in favour of the Svetol™ group and shows that Svetol™ is reducing the glucose absorption on average by 20% in the 15 participants. The observed weight loss in this study (without diet and physical exercise) is 1.5 kg in 6 weeks.

Three of the participants reported side-effects as headache and nausea in connection with intake of Svetol™.

#### **Study II**

The results from this study show that intake of 2 capsules a day combined with diet gives an average weight reduction of 5.0 kg in 60 days. In the placebo group the reduction was 2.4 kg. The difference is statistically significant in favour of the Svetol™ group ( $P < 0.05$ ). The tolerability was comparable in the two groups and none of the participants stopped the treatment due to side-effects.

#### **Study III**

The results from this single dose study show that an intake of 10g CoffeeSLENDER® reduces the glucose absorption significantly. If the area under the curve (AUC) is calculated after a normal glucose loading with the trapeze method the area is 778 mmol/l/min. After intake of 10g CoffeeSLENDER® the area is reduced to 724 mol/l/min. Intake of normal coffee and decaffeinated coffee does not show this effect. The areas are 788 and 818 mo/l/min, respectively. The study results are shown in figure 2. Step 1 shows the profile after the glucose loading, Step 2,3 and 4 after CoffeeSLENDER®, normal coffee and decaffeinated coffee, respectively. Further studies are in progress to investigate the dose-response effect of CoffeeSLENDER® and the preliminary results show a strong dose-response relation.

#### **Study IV**

The study was carried out as an open study in order to investigate the daily intake of CoffeeSLENDER® on body weight. The recommended dose was 3 cups per day, and no advices were given about diet and physical exercise. Sixty persons with mild to moderate overweight participated. The study had a duration of 3 months.

The results show an average weight reduction of 5.4 kg. Tolerability was excellent and all participants performed the study according to the protocol.

## **Conclusion**

The results from our international projects show that chlorogenic acid in form of capsules or as an ingredient in coffee has a clear cut effect on the glucose absorption. More studies have to be carried out before we have an understanding of the mechanism of action. We have shown that it is a significant reduction of the glucose absorption both with Svetol™ and CoffeeSLENDER®.

For CoffeeSLENDER® we have shown a clear dose-response relation on the absorption of glucose.

Data with respect to weight reduction shows that both Svetol™ and CoffeeSLENDER® can induce an acceptable weight reduction when used daily for a period of 6-8 weeks.

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