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Chocolate with High Cocoa Content as a Weight-Loss Accelerator

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Methodology: In a study consisting of several weeks, we divided men and women between the ages of 19-67 into three groups. One group was instructed to keep a low-carb diet and to consume an additional daily serving of 42 grams of chocolate with 81% cocoa content (chocolate group). Another group was instructed to follow the same low-carb diet as the chocolate group, but without the chocolate intervention (low-carb group). In addition, we asked a third group to eat at their own discretion, with unrestricted choice of food. At the beginning of the study, all participants received extensive medical advice and were thoroughly briefed on their respective diet.

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Chocolate with High Cocoa Content as a Weight-Loss Accelerator

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Result: Subjects of the chocolate intervention group experienced the easiest and most successful weight loss. Even though the measurable effect of this diet occurred with a delay, the weight reduction of this group exceeded the results of the low-carb group by 10% after only three weeks ($p = 0.04$). While the weight cycling effect already occurred after a few weeks in the low-carb group, with resulting weight gain in the last fifth of the observation period, the chocolate group experienced a steady increase in weight loss. This is confirmed by the evaluation of the ketone reduction. Initially, ketone reduction was much lower in the chocolate group than in the low-carb peer group, but after a few weeks, the situation changed.

The low-carb group had a lower ketone reduction than in the previous period, they reduced 145 mg/dl less ketones, whereas the chocolate group had an average reduction of an additional 145mg/dl.

Effects were similarly favorable concerning cholesterol levels, triglyceride levels, and LDL cholesterol levels of the chocolate group.

Moreover, the subjects of the chocolate group found a significant improvement in their well-being (physically and mentally). The controlled improvement compared to the results of the low-carb group was highly significant ($p < 0.001$).

Conclusion: Consumption of chocolate with a high cocoa content can significantly increase the success of weight-loss diets. The weight-loss effect of this diet occurs with a certain delay. Long-term weight loss, however, seems to occur easier and more successfully by adding chocolate. The effect of the chocolate, the so-called "weight loss turbo," seems to go hand in hand with personal well-being, which was significantly higher than in thecontrolgroups.

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I. Introduction

Although there has been an increased focus on the beneficial properties of high cocoa content chocolate in recent years, there are still very few studies concerning its use in weight-loss diets.

A large number of studies have proven the positive health effects of chocolate on thecoronary vasculature[1], insulin secretion[2,3,4]and endothelial function[5,6]. Additionally,the lowering effects of dark chocolate on high blood pressure have already been welldocumented.[78]Moreover, in a systematic review, Ried et al. were able to prove its health benefits and antihypertensive effect.[9]

In terms of nutritional interventions, there have been interesting first attempts with the use of chocolate. In 2012, Golomb et al. showed a connection between regular chocolate consumption and a lower body mass index.[10]However, this study was limited to the mere collection and analysis of chocolate consumption and a possible connection to the BMI.

Moreover, recent research approaches suggest that the selective use of high cocoa content chocolate can also support active weight loss. A long-term study with mice shows that even with a high-fat diet combined with high cocoa content chocolate, the weight of laboratory mice remains low.[11]A similar study with humans has not been published yet.

II. Methodology

a) Study Design

The study is based on the evaluated results of three parallel groups that underwent various dietary interventions in January 2015. They were under medical supervision and were examined at the beginning, divided into groups, instructed, and measured. During the collection period, the participants' data was retrieved in two-day intervals to ensure the regularity of measurement results. In addition to the mere weight loss, there was an emphasis on the documentation of

the well-being of the subjects, as this is considered key to long-term weight loss.[12]

b) Study Participants

To obtain a genuine, non-preselected representation of the general public, the study participants were recruited without further requirements. On average, participants were 29.6 years old and weighed 81.5 kg. Their average BMI was 26.16; the lowest BMI was 19.15, the highest at 39.95.

To represent the disproportionate number of female dieters in the general public, two-thirds of the participants were female, and one-third male.

The participants were healthy or had medical conditions for which a nutrition intervention represents a generally medically accepted form of therapy.

c) Randomization

After a detailed preliminary, the participants were randomly assigned one medical group from three different batches of diet instructions. For both the study participants and for the authors of this study, the grouping of the participants was unforeseeable.

d) Interventions / Measures

Participants were assigned to the following groups: low-carb diet plus high cocoa content chocolate (chocolate group), low-carb diet (low-carb group), and the control group.

The participants of the chocolate group were told to eat as many low-carbohydrate foods as possible, and to increase the protein and fat content of their diet. Additionally, they were given 875 grams of chocolate with a cocoa content of 81 percent. They were asked to consume a daily dose of 42 grams of chocolate in addition to the low-carb diet. Over a period of three weeks, 100 percent of the subjects adhered to this requirement.

The participants of the low-carb group were instructed to change their diet to a low-carbohydrate diet. Concerning the diet, their instructions were absolutely identical with those of the chocolate group.

Nutrition interventions that apply a low-carbohydrate diet are currently the most applied approach to a weight-loss diet, which is particularly recommended in the S3-guidelines on "Prevention and Treatment of Obesity."[13]

Participants in the control group were encouraged to continue their previous eating habits. It should be noted that the study was conducted in early January, after the Christmas / New Year celebrations.

e) Testing Methods

In addition to the continuous measurement of weight development, participants were asked to do routine testing of the urine with multiparameter stripson a daily basis by using test strips, and to document their mental state and their sleep behavior.

At the beginning and end of the study, a blood test was conducted; weight, BMI, and waist-to-hip ratio were documented; and the Giessen Subjective Complaints List, which measures the change in well-being on a scientifically sound basis, was evaluated.[14]

The main focus within the blood parameters was on the changes in lipid levels and liver values, as well as the possible increased amount of protein in the blood. Previous studies have shown that a unilateral low-carb diet can lead to some dramatic changes in the albumin value.[15]Concerning the evaluations, we took into consideration changes of cholesterol, triglycerides, LDLcholesterol, ALT, GGT/GGTP, and the albumin.

Additionally, we observed the changes of ketone reduction in urine.

f) Statistics

A t-test for independent samples was used to assess differences in baseline variables between the groups. The analysis was a repeated-measures analysis of variance in which the baseline valuewas carried forward in the case of missing data. One subject (low-carbohydrate) had to be excluded from the analysis, because of a weight measure issue within the trial.

III. Results

a) Weight Development

Both the participants of the chocolate group and the low-carb group lost weight, whereas the control group gained weight during the study period.The subjects of the low-carb group lost 3.1 percent of their body weight in 21 days and the chocolate group lost 3.2 percent. The participants of the control group were on average 0.7 percent heavier. The body mass index decreased in the chocolate group to 0.93, in the low-carb intervention group by 0.95 points, whereas the control group gained 0.7 points.

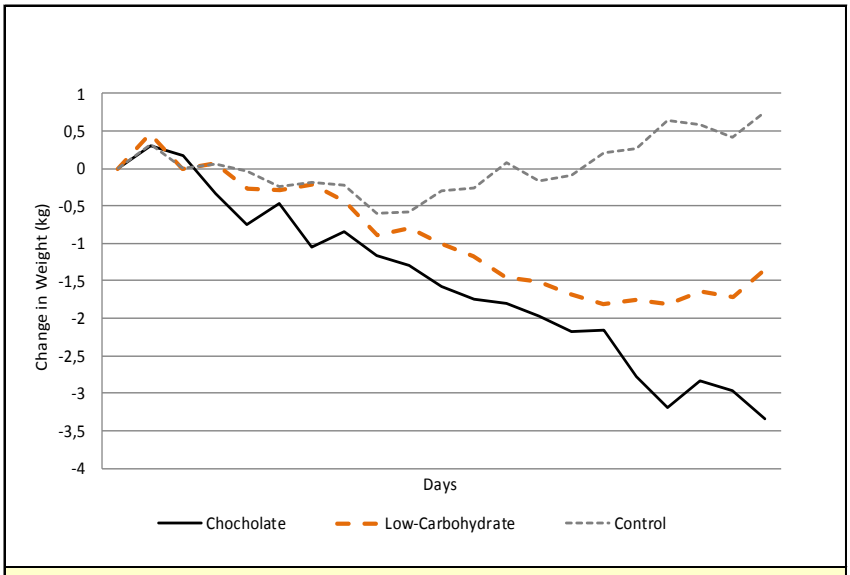

Figure 1 : Daily weight development by group

Remarkably, participants in the chocolate group lost more weight than those of the low-carb group. The temporal course of the weight-loss success is also worth noting: the course of the intervention period shows that there were marked differences in both groups. While the low-carb group lost weight from the beginning and continued this weight loss during the first thee quarters of the testing period, the chocolate group gained weight in the first quarter before they started to lose considerably more weight than the low-carb group.

In the third quarter, the weight-loss ratio of the low-carb group came to its minimum, while the chocolate group lost considerably more weight during the third consecutive quarter than prior, and significantly more than both of the control groups combined.

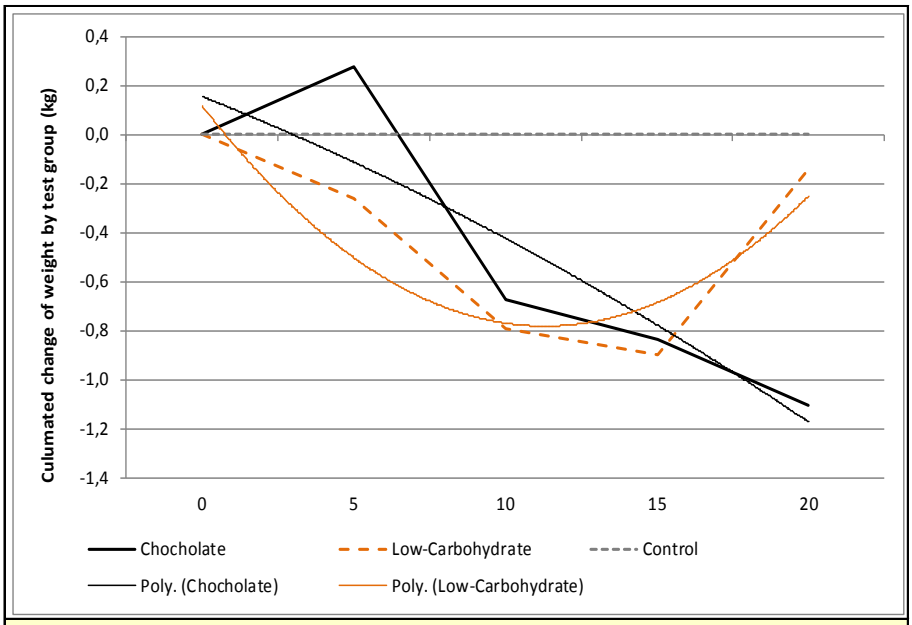

Figure 2 : Culumated change of weight by test group

b) Ketones

A higher amount of ketones could be detected in the participants of the chocolate group than in the low-carb group. The measured results were found to be highlysignificant($p<0.01$).

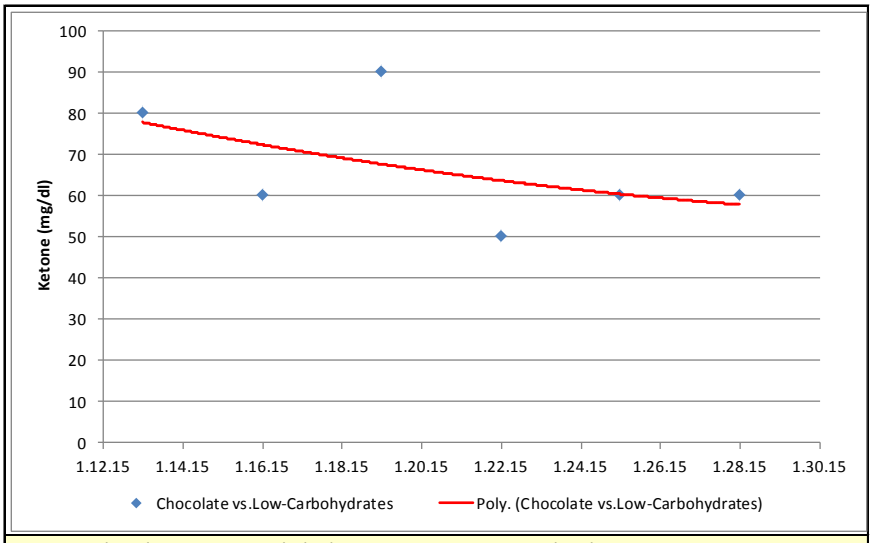

Figure 3 : Chocolate vs. Low-Carbohydrate - Variance in Ketone levels
Data was collected from an urine test strip and converted into a nominal scale before the analysis.

c) Lipid Levels

Cholesterol levels as well as triglycerides and LDLcholesterol concentrations improved significantly in participants of the chocolate group in comparison to the low-carb group.

d) Liver Values

Participants of the chocolate group also showed the most significant changes in ALT and GGT/GGTP values.

e) Albumin

While the measured urinary protein breakdown increased significantly in the low-carb group, the proportion in the chocolate group increased by only one-sixth.At the end of the testing period, the protein detected in the control group's urine was lower than the initially measured values.

Table 1 : Absolute changes in lipid levels, liver values, and albumin values in an analysis that include data on all subjects in the relevant groups.

Variable	Chocolate Diet		Low-Carbohydrate		P-Value
Cholesterol (mg/dl)					
Day 21	-12,2	± 26,7	2,3	± 15,9	0,19
Triglycerides (mg/dl)					
Day 21	-22,6	± 85,7	3,0	± 41,3	0,55
LDL cholesterol (mg/dl)					
Day 21	-17,4	± 22,8	-5,0	± 22,4	0,00
ALT (U/l)					
Day 21	-6,4	± 6,7	-11,5	± 3,6	0,11
GGT/GGTP (U/l)					
Day 21	-8,8	± 5,5	-2,0	± 0,0	0.23
Albumin (g/dl)					
Day 21	0,0	± 0,4	0,1	± 0,3	0.23

Plus-minus values are means ±. The chocolate group had 5 subjects, in the low-carbohydrate group only 4 subjects could be considered.
P values are for the differences between the two groups.

f) Giessen Subjective Complaints List

We also found highly significant differences with regard to physical and psychological ailments, which we obtained with the help of the Giessen Subjective Complaints List. Although the perception in the low-carb group and control group did not change by much, the participants of the chocolate group felt much better on average.Exhaustion symptoms in particular, such as fatigue or the sensation of heavy legs, significantly decreased in the chocolate group. The significance of this survey was $p < 0.001$.

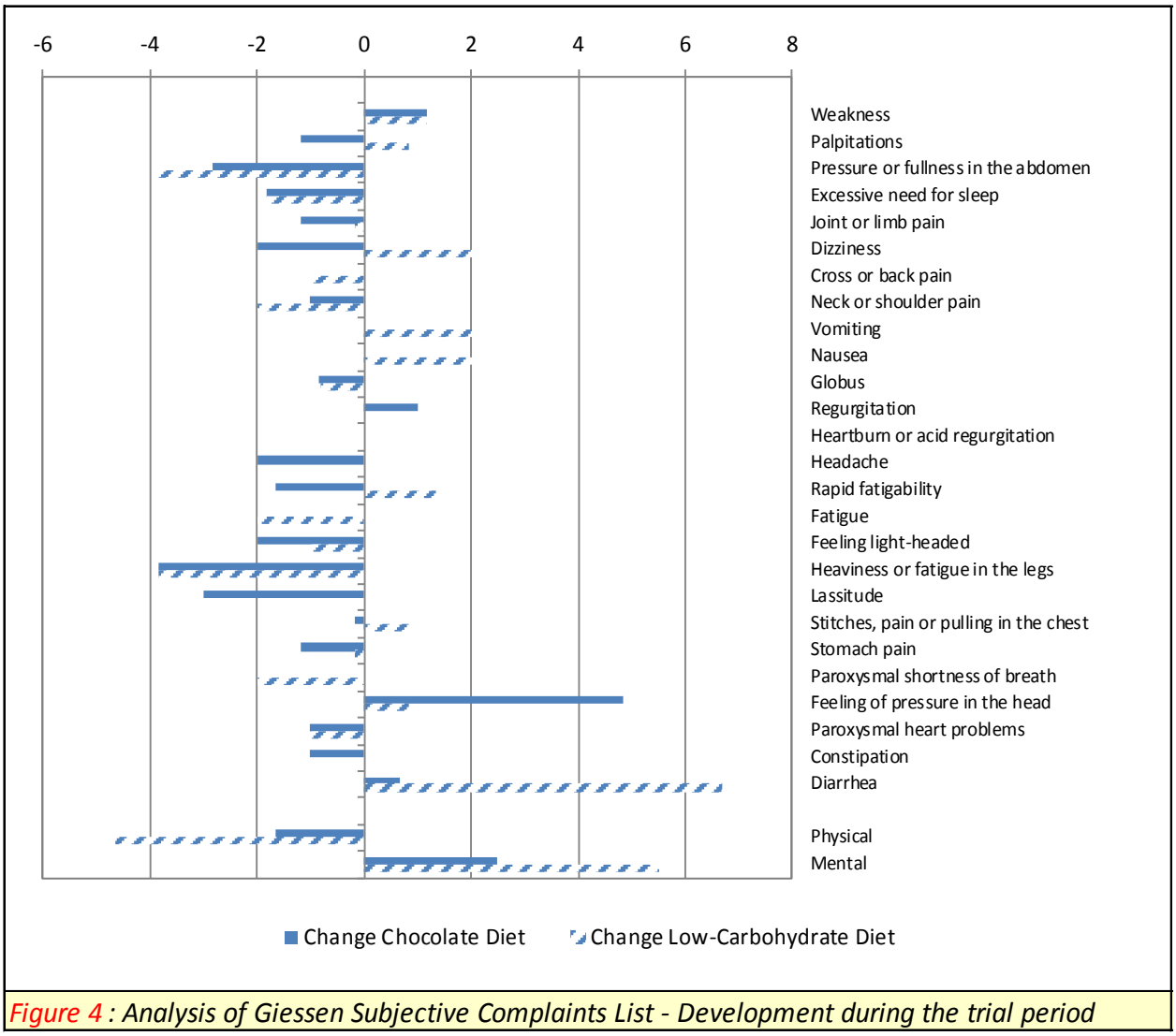

Figure 4 : Analysis of Giessen Subjective Complaints List - Development during the trial period

IV. Conclusion

The results of this study show that the addition of high cocoa content chocolate can actually be used as a supportive measure in nutritional interventions. However, the focus should not remain on the slightly greater weightloss of the chocolate group compared to the low-carb group, but on the weight development.

High cocoa content chocolate could be the key to solving the biggest problem of all nutritional interventions. "Weight cycling"' is, for example, associated with increased bone loss ratio in the hip and the lumbar area, and with an increased risk for loss of bone density.[16]

Moreover, several studies have shown additional risks of significant weight gain (increased risk of cardiovascular and all-cause mortality, of hypertension in obese women, and symptomatic gallstones in men).[17,18,19,20]

Many weight-loss diets share the common factor of weight gain within several months after a short and often significant weight reduction. This applies to almost all of the weight-loss programs recommended by the Deutsche Adipositasgesellschaft. In studies focusing on the *Weight Watchers* program, participants in the commercial program gained back weight after the 26th week.[21]In a study of the medical outpatient intervention program *Bodymed*, Walle et al. found that the continuous slimming effect of the mean body weight also stopped after 26 weeks.[22]The same applies to the OPTI FAST program.[23]

In 2003, Foster et al. proved in their groundbreaking, randomized study on a low-carb diet that the effect of weight reduction or greater weight loss compared to a low-fat intervention is not significantly detectable after one year.[24]

Consequently, the weight gain of the low-carb group in this study is in line with previous research. The different weight development course of the chocolate group is therefore all the more impressive. Remarkably, "weight cycling" is not detectable in this group. The initial slight weight gain is currently inexplicable to us. It may

be related to the body's response to the flavanols or to other factors that were not the focus of this study. However, it is more important to consider the blood and fat levels. Thus, the values of the chocolate group on average improved not only considerably more than those of the low-carb group, but they even resulted in better LDL levels after just three weeks compared to levels participants reached after three months in diet groups graded by the professional associations with the quality level S3 (highest stage) and the recommendation grade A (the highest level).

The albumin values of the study participants are also worth mentioning. Criticism of low-carb diets always broaches the issue of excessive protein intake. One suspects that this may lead to an increased risk of coronary artery disease.[25]

Unlike the participants in the low-carb group, however, the chocolate group showed hardly any increase of albumin degradation. It was lower by a factor of 6. The risk for coronary heart disease should therefore be much lower.

Considering all of these results, it is not surprising that the chocolate group participants felt significantly better than those in the other two groups. Therefore, we recommend the consumption of high cocoa content chocolate during nutritional interventions. The positive effects that have been proven in laboratory mice seem to be relevant to humans.

The authors of this study believe that high cocoa content chocolate is therefore an ideal "weight-loss turbo" if used in combination with a low-carb intervention for weight loss.

Further studies should examine the suitability of this highly efficient weight-loss accelerator for other intervention programs.

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