Morning chocolate benefits

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A recent study suggests surprising benefits of morning chocolate consumption, including increased fat burning and reduced blood glucose levels ([1]).

The study is a small (n=19) randomized controlled, cross-over trial of postmenopausal women (mean age 52) with normal BMI who consumed either 100g (~33% of their daily energy intake) of milk chocolate in the morning with breakfast (within one hour of waking) or at night (within one hour before bedtime). Chocolate was not consumed outside of these times, during which participants could eat their regular diet. Participants were randomly assigned to consume morning chocolate for 2 weeks, evening chocolate for 2 weeks, or 2 weeks of abstaining from chocolate, with a one week washout period between each intervention (total duration 9 weeks). Weight gain and other outcome measures were compared to no chocolate intake ([1]).

Results showed that 2 weeks of chocolate consumption did not lead to weight gain, regardless of the timing, but the timing did have differing effects on energy expenditure, hunger and appetite, sleep and gut microbiome composition. A high intake of chocolate during the morning hours resulted in reduced energy intake, a 25.6% increase in fat burning, a 1.7% decreased waist circumference and a 4.4% reduced fasting glucose, while evening/night chocolate altered next-morning resting and exercise metabolism ([1]).

The following potential mechanisms may explain the lack of weight gain with chocolate intake.

Reduction in ad libitum *energy intake*

Ad libitum energy intake was reduced following chocolate consumption which is consistent with previous results showing a reduction in hunger, appetite and the desire for sweets ([2]). This study shows reduced energy intake when consuming milk chocolate, which has been shown to

have less of an effect in decreasing appetite than dark chocolate ([3]). Components of chocolate, such as epicatechin, may account for this compensatory effect ([4]). The macronutrient composition of milk chocolate which is rich in fat (31 g) and carbohydrates (58.4 g), and low in proteins (6 g), may also account for this caloric compensation; when eating chocolate in the morning, participants decreased their *ad libitum* energy intake by reducing fat and carbohydrates without significant changes in proteins. Daily cortisol levels were lower when eating chocolate in the morning than in the evening/night. Lower cortisol levels are associated with a lower stress-related appetite ([5]) which might help to explain the better caloric compensation in this study. In addition, the decreased desire for sweets could be related to reduced cravings and improved diet satisfaction ([6]).

It is interesting to note that morning chocolate consumption resulted in an *ad libitum* energy intake reduction of 300 kcal/day, compared to baseline while evening chocolate consumption resulted in a 150 kcal/day reduction in energy intake. In neither situation did the reduction equal the energy contribution of the chocolate (542 kcal/day).

Increased energy expenditure

Evening/night chocolate consumption led to a 6.9% increase in physical activity, a 1.3% increase in heat dissipation after meals and a 35.3% increase in carbohydrate oxidation. Increased body temperatures could indicate that more calories were being burned when at rest ([1]).

Changes in sleep and circadian related variables

Evening chocolate consumption induced more regular timing of sleep episodes with lower variability of sleep onset than morning consumption ([1]).

Changes in gut microbiota profiles and function

Changes in gut microbiota profiles and function are marked mostly by changes in short-chain fatty acid (SCFA) production, which might account for the significantly lower hunger and appetite reported by participants ([7]).

Studies using dark chocolate indicate that once reaching the intestine, cocoa polyphenols interact bidirectionally with the gut microbiota, enhancing the growth of beneficial gut bacteria, such as *Lactobacillus* spp. and *Bifidobacterium spp.* (Actinobacteria phylum), while reducing the number of pathogenic bacteria, such as *Clostridium perfringens* (Firmicutes phylum) ([8],[9]). In the present study, results with milk chocolate, compared to no chocolate intake, showed increased abundances of Actinobacteria and reductions in the relative abundance of Firmicutes. In addition, milk chocolate intake increased the abundance of *Akkermansia*, *Ruminococcus* and *Dorea* genus ([1]). A lower *Akkermansia muciniphila* abundance has been associated with obesity, and type 2 diabetes mellitus ([10],[11]), while increased levels of *Ruminococcus* have been found after consumption of high carbohydrate diets with fibre ([12]).

Discussion

Chocolate eating has been associated with long-term weight gain in a dose-dependent manner, especially in postmenopausal women ([13],[14]) who are particularly vulnerable to weight gain. However, a meta-analysis of randomized clinical trials found that chocolate supplementation does not change body weight or body fat distribution, although a subsequent subgroup analysis following dose-response evaluations indicated that chocolate consumption (as compared to no chocolate) resulted in waist circumference reduction ([15]). Experimental studies show that cacao decreases fat accumulation by decreasing lipogenic enzyme expression while increasing lipolytic enzyme expression ([16],[17]). Other evidence indicates that chocolate may have beneficial effects on glycaemic control ([18]). Most clinical trials have been performed with dark chocolate (35-85% of cocoa), while milk chocolate, with less cocoa content (~10-35%), is still the most popular when it comes to candy bars and sweet treats. Importantly, previous studies did not consider the effects of chocolate consumption timing on health parameters. Food timing is a relevant factor in obesity and weight loss ([4],[19],[20],[21]).

This is a small, short term study, and further long term studies are required to confirm the effect on weight gain over a longer time frame. In addition, the participants were postmenopausal women with normal BMI, therefore weight gain and metabolic results might not be generalizable to the general public. Furthermore, this study does not allow the distinction of whether the reported effects are consequences of the rewarding effect of chocolate, specific chocolate components (such as epicatechins), or of the high energy and high sugar content of chocolate. Nonetheless, the study provides some good news in time for your Christmas morning treat or Christmas Eve chocolaty nightcap, so long as you consume it during a ~1 hour time window and abstain for the rest of the day! Enjoy!

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