



A randomized controlled pilot study to assess

EFFECTS OF A DAILY PISTACHIO AFTERNOON SNACK

on next meal energy intake, satiety and anthropometry in healthy women.

WHY THE STUDY WAS DONE

Pistachios are a food of high nutrient quality containing protein, fiber, phytosterols, and antioxidants and are naturally cholesterol-free. California-grown pistachios have a high monounsaturated fatty acid content (53% of total fat) and a high unsaturated/saturated fat ration of 6.8: 1 (USDA 2016)

In spite of their favorable nutrient profile, many consumers are often reluctant to include pistachios frequently in their diet due to concerns regarding weight gain.

In contrast to consumers' reluctance, scientific works suggest that the energy load of oleaginous fruits such as pistachios is associated with high satiety efficiency (Mattes & Dreher 2010). Satiety is the power of ingested food to inhibit further eating following consumption. Foods with a high satiety power are thought to facilitate the control of food intake and body weight (Hetherington et al 2013; Bellisle and Blundell 2013). Many foods are now proposed to consumers with "satiety claims" that suggest that the consumption of such foods can help delay the return of hunger following meals, help one to eat less, and perhaps also help with weight control.

Researchers wanted to investigate the consumption of pistachios as a snack food and their effect on satiety, energy, macro- and micro-nutrient intake and effect on body composition.

OBJECTIVES

The goal of the study was to evaluate the effect of adding pistachios as an afternoon snack in the workplace or at home and the effect on:

- Satiety
- Energy and nutrient intake
- Body weight and composition

TARGET POPULATION

60 healthy, sedentary women ages 18 – 50.

DESIGN

This research was a non-interventional, pilot, monocentric, randomized controlled open trial including two parallel groups.

All participants underwent a medical examination and anthropometric measures were taken including weight, height, waist and hip circumferences and body composition.

Subjects were randomized into two groups determined by a computer randomization schedule. The Experimental Group received California-grown pistachios and the Control Group received a popular high protein Gouda biscuit sold in French grocery stores.

During a four-week intervention, participants in each group were required to ingest a fixed pre-packaged serving of California-grown pistachios or cheese aperitif biscuit which was matched for protein and calorie content. The snack was in addition to normal daily food intake. Snacks were consumed once a day as an afternoon gouter.

DAILY SNACK

Pistachios (56 grams, about 315 kcal)

Cheese aperitif biscuit (56 grams, about 315 kcal)



MAIN OBSERVATION INDICATORS

- 1 Sensations of hunger, fullness and desire to eat at predetermined times: before and after all main meals and before and after the afternoon snack.
- 2 Anthropometric measurements taken at the end of the study.
- 3 Three day food records collected from all participants at the end of week 1 and week 4 and analyzed for energy, macronutrients and selected micronutrient intake.

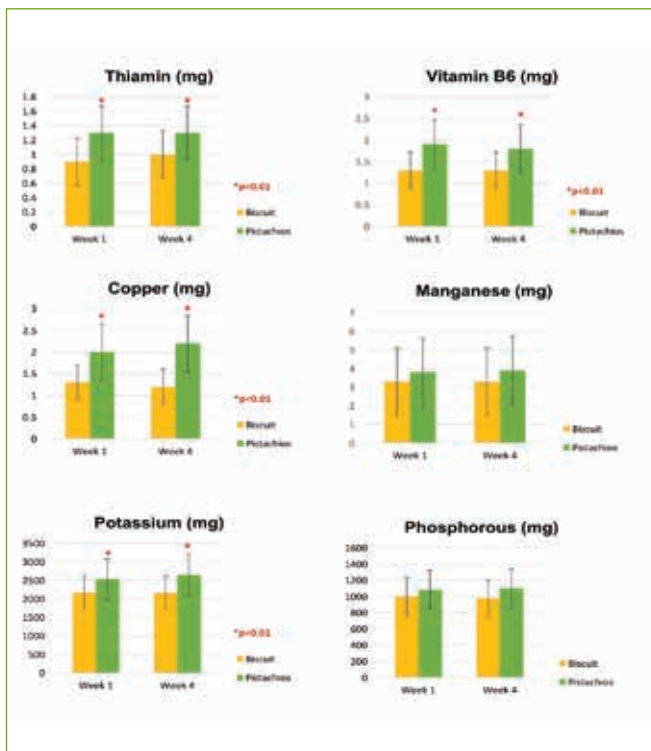
RESULTS

- A trend appeared in the pistachio group towards a reduction in waist size after 4 weeks.
- Body fat remained stable in the pistachio group while it rose slightly in the control group.
- Lean mass declined slightly in the control group while it remained stable in the pistachio group.
- The consumption of thiamin, vitamin B6, copper and potassium was greater in the pistachio group than in the control group at both week 1 and week 4.
- The weight of the participants did not change between the beginning and the end of the intervention.
- No significant difference ($p < 0,05$) appeared between groups regarding energy consumption at dinner or the hunger/satiety scores.

CONCLUSION

In this study adding a daily snack of 315 kcal had no negative impact on body weight and composition. Women who consumed pistachios, however had a higher intake of selected micronutrients and the study suggests a trend towards a reduction in waist size. There were no differences in energy intake or measures of satiety between women who consumed pistachios or biscuits. This could be explained by the fact that protein and energy content of the snacks were closely matched. This may be critical in explaining the satiety effect of nuts.

NUTRIENT INTAKE



Study product's nutrients	Pistachios (per 100g)	Gouda Aperitif Biscuits (per 100g)
Energy (kcal)	564	562
Water (g)	3	3
Proteins (g)	21	19
Carbohydrates (g)	19	44
Fibres (g)	9.9	2.2
Fat (g)	45	34
Saturated (g)	5.5	16
Mono-unsaturated (g)	25	ND
Poly-unsaturated (g)	13	ND
Salt (%)	0.96	2.1
Sodium (g)	0.38	0.84
Thiamin (mg)	0.7	0.12
Vitamin B6 (mg)	1.1	0.063
Potassium (mg)	1010	135
Phosphorus (mg)	469	250
Copper (mg)	1.3	0.11
Manganese (mg)	1.2	0.71

A randomized controlled pilot study to assess effects of a daily pistachio (*Pistacia vera*) afternoon gouter on next meal energy intake, satiety and anthropometry in healthy women.

France Bellisle*¹, Anestis Dougkas², Agnès Giboreau², Arianna Carughi³, Jennette D. Higgs⁴, Janice I. Harland⁵

¹Nutritional Epidemiology, University of Paris 13, Bobigny, ²Institut Paul Bocuse, Ecully, France,

³American Pistachios Growers, Fresno, United States, ⁴Food To Fit, Greens Norton, ⁵Harland Associates, Cirencester, UK

Introduction and Objectives

Nuts, including pistachios, are high in fiber, protein and polyunsaturated fats which have been shown to enhance satiety and reduce subsequent food intake. Previous studies have shown that including nuts in the diet does not lead to weight gain and may improve appetite control. The present non-interventional study investigated daily consumption of pistachios as an afternoon snack in the workplace or at home and its effect on satiety, energy and nutrient intake (both macro and selected micronutrients), and body weight and composition.

Materials and Methods

This was a non-interventional, pilot, monocentric, randomised, controlled open trial including two parallel groups each of 30 healthy, sedentary women ages 18 – 50. Over a period of four weeks, groups consumed either 56 grams (315Kcal) of roasted, lightly salted pistachios or 56 grams of isocaloric/equiprotein popular, commercially available, savoury biscuits. Evening energy intake after the afternoon snack; changes in anthropometric measures (i.e. body weight, waist and hip circumferences, waist/hip circumferences ratio, fat and lean body masses and fat/lean body masses ratio) and daily intake of energy, macronutrients and selected micronutrients were assessed. Visual analog scale (VAS) individual score for hunger, thirst, fullness, desire to eat and prospective were measured at week 1 and week 4.

Figure 1. Study design and subject distribution

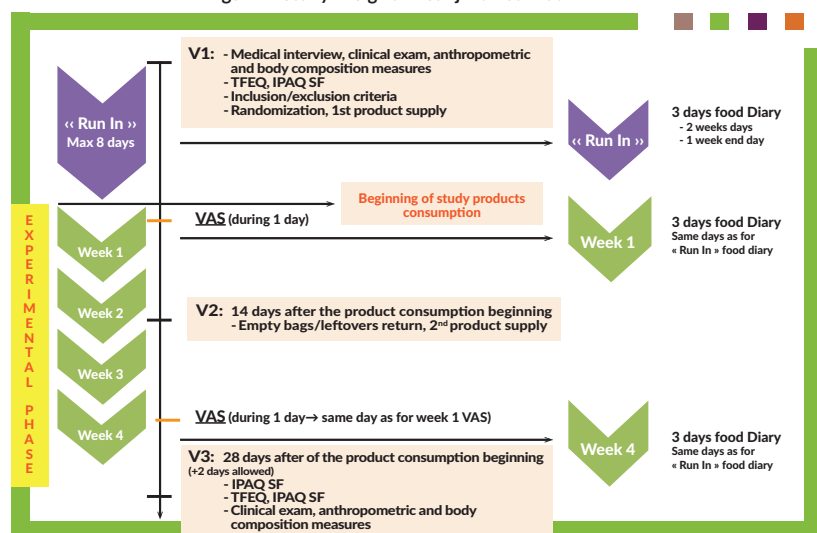


Figure 2. Subject distribution

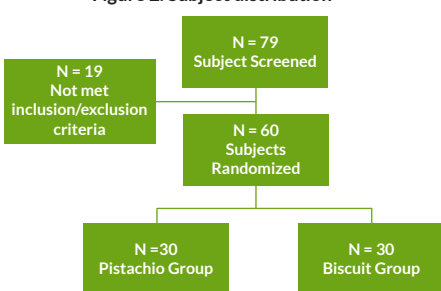
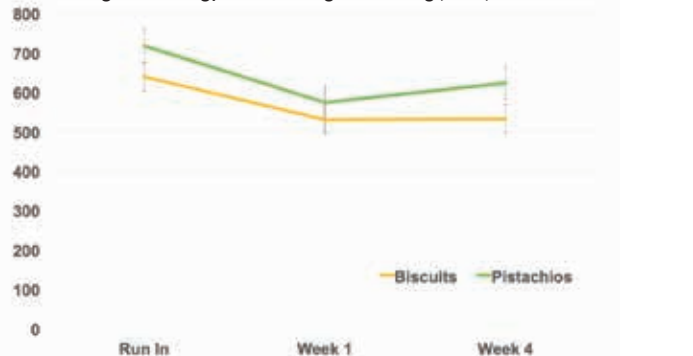


Table 1. Details on study products

Product	Composition	Amount
Pistachios (<i>Pistacia Vera</i>)	Pistachios, salt	56 grams per bag
Gouda biscuits	Wheat flour - hydrogenated and non hydrogenated vegetal oils (sunflower, rape, copra, emulsifier: E471, acidifier: E270, aroma) - cheese whose gouda 15% (milk, salt, lactic ferments, rennet, preservative: E251, dye: E160b) - yeast - powder milk partially skimmed - salt 1.4% - potato modified starch - breadcrumb (wheat flour, salt, yeast, dyes: E100, E160b) - spices - emulsifier: E471 - onion powder - dye: E160c - antioxidant: E306 (whose soy oil extract). Traces of eggs and nuts.	56 grams per bag

Figure 3. Energy intake during the evening (kcal)



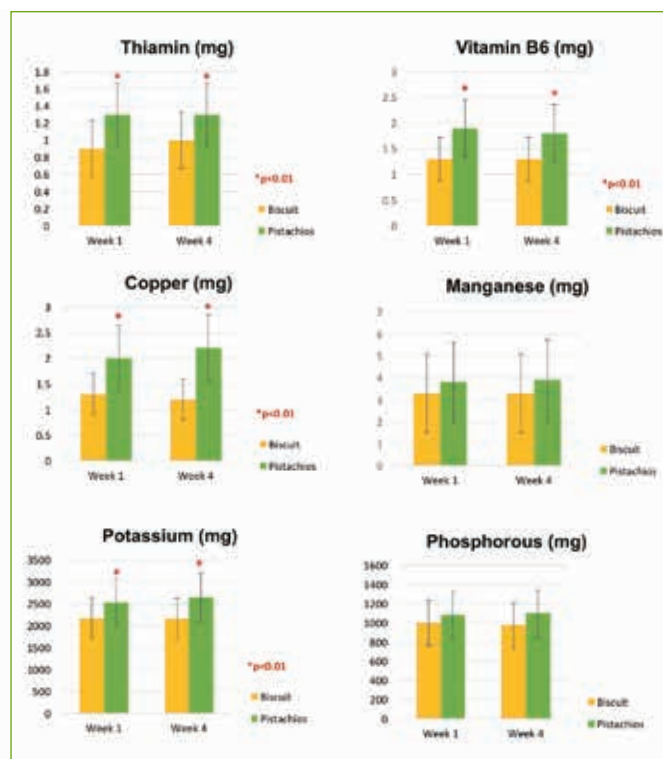
Energy intake during the evening after the afternoon gouter (until bedtime or midnight, mean of the 3-day food diary). In Pistachios group, no statistically significant difference was observed between Week 1 and Week 4 ($p=0.3136$). In Biscuits groups, no statistically significant difference was observed between Week 1 and Week 4 ($p=0.9595$).

Results and Statistical Analysis

Table 2. Anthropometric Measures

Parameter	Week 1		Week 4		P value (difference between products on Week 3-Week 1)
	Biscuit (n=30)	Pistachio (n=30)	Biscuit (n=30)	Pistachio (n=30)	
Weight (kg)	57.3 (5.77)	58.5 (5.96)	57.4 (5.5)	58.7 (6.2)	P = 0.9696
Waist circumference (cm)	74.8 (7.0)	74.2 (5.04)	74.7 (7.0)	73.6 (5.0)	P = 0.2966
Hip circumference (cm)	94.6 (5.20)	96.3 (5.61)	94.4 (5.07)	96.0 (5.3)	P = 0.9368
Ratio waist/hip circumference (cm)	0.8 (0.5)	0.8 (0.05)	0.8 (0.06)	0.8 (0.05)	P = 0.1418
Body fat mass (%)	24.9 (6.02)	25.0 (3.63)	25.4 (6.11)	25.0 (3.61)	P = 0.2950
Lean body mass (%)	75.1 (6.02)	75.0 (3.63)	74.6 (6.11)	75.0 (3.61)	P = 0.2950
Fat body mass/lean bodymass	0.4 (0.10)	0.4 (0.10)	0.4 (0.10)	0.4 (0.10)	P = 0.6112

Figure 4. Nutrient Intake



Results

There were no significant ($p < 0.05$) differences in evening energy intake between the groups nor in VAS scores.

There were no significant ($p < 0.05$) anthropometrics and body composition measures. Neither consuming pistachios nor biscuits had an impact on body weight. Anthropometric measurements remained linear throughout the study in spite of the additional calories.

There was a trend towards lower waist circumference after 4 weeks among women who consumed pistachios.

Fat body mass remained stable among women consuming pistachios while it slightly increased among those consuming biscuits. Concomitantly, lean body mass slightly decreased in among this group but did not change among women consuming pistachios.

Thiamine, vitamin B6, copper and potassium intakes are significantly higher at week 1 and week 4 (end of study) for volunteers who consumed pistachios compared to those who consumed biscuits.

Conclusion

There were no differences in either evening energy intake or measures of satiety between women who consumed pistachios or biscuits. This could be explained by the fact that protein and energy content of the snacks were closely matched. These may be critical in explaining the satiety effect of nuts. In this study adding a daily snack of 315 kcal had no negative impact on body weight and composition. Women who consumed pistachios, however had a higher intake of selected micronutrients.