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AMERICAN
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FILE: ■ Almonds (*Prunus dulcis*)
■ Antioxidant
■ Smoking

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Re: Almond Consumption Reduces Oxidative Stress in Smokers

Li N, Jia X, Chen C-Y O, et al. Almond consumption reduces oxidative DNA damage and lipid peroxidation in male smokers. *J Nutr.* 2007;137:2717-2722.

The World Health Organization reports that smoking is among the 10 greatest risks to health because of its strong association with several forms of cancer, cardiovascular diseases, and pulmonary disorders. The reactive oxygen and nitrogen species in cigarette smoke can induce oxidative stress and can cause smoking-related pathologies. Clinical trials have shown that supplementation with certain dietary antioxidants can decrease several biomarkers of oxidative stress. These authors, from the Chinese Center for Disease Control and Prevention and the USDA Human Nutrition Research Center on Aging at Tufts University, investigated whether the consumption of almonds, which contain antioxidants, decreases biomarkers of oxidative stress in young male smokers.

The investigators recruited 60 male soldiers (aged 21.8 ± 0.2 years) who were habitual smokers (5-20 cigarettes per day with a history of smoking for 5 or more years). The soldiers lived in a single military camp of the Chinese Army in Beijing. They recruited 30 nonsmoking volunteers (aged 21.5 ± 0.4 years) from the same camp to serve as a reference group. To be eligible, the participants had to be healthy, with no history of cardiovascular, hepatic, gastrointestinal, or renal disease; with no alcoholism; and with no use of antibiotics, functional foods, or dietary supplements during the 4-week run-in period before the study.

All participants ate the same meals every day in the canteen and all performed only light physical activity during the study. All smokers maintained their usual smoking habits. Dietary intakes were assessed the week before the trial and the first and last week of each 4-week treatment period by using self-administered questionnaires. Intakes of protein, fat, and carbohydrate were calculated by using the China Food Composition 2002 database.

For this placebo-controlled, crossover clinical trial, the 60 smokers were randomly assigned to 2 equal-size subject groups (A and B). In addition to the standard diet served in the canteen, whole

almond powder (84 g or 2.9 oz., equivalent to about 70 almonds) (provided by the Almond Board of California in Modesto) or pork (120 g) was provided daily to participants in their respective groups for 4 weeks. The nonsmoking reference group was supplemented with 120 g pork per day during the 4-week study period. A 4-week washout period with no nuts or dietary supplements was followed by a 4-week crossover treatment period.

Four overnight fasting blood samples and four 24-hour urine samples were collected from all the smokers and 2 sets of samples were collected from the nonsmokers before and after the intervention. The following values were assessed and recorded: α -tocopherol in serum samples; blood clinical chemistries and urinary cotinine; urinary 8-hydroxy-deoxyguanosine (OHdG); DNA strand breaks; urinary malondialdehyde (MDA); and plasma superoxide dismutase (SOD), glutathione peroxidase (GPX), and catalase.

Regarding their statistical analysis, the authors report that two-factor repeated-measures analysis of variance (ANOVA) of subject group (A vs. B [almond-pork vs. pork-almond]) and treatment (almonds vs. pork) and their interaction was included to compare differences of pre- and post-treatment in measured variables. Significant differences between smokers and nonsmokers at baseline, as well as between smokers consuming the almond diet and nonsmokers consuming the pork diet at the end of intervention, were assessed by a student's *t* test. Pearson correlation between urinary cotinine or number of cigarettes smoked and biomarkers of oxidative stress was also examined. Differences with $P \leq 0.05$ were considered significant. The authors used the SAS program (version 8.2, SAS Institute) to perform all statistical analyses.

The authors report the following results:

- Baseline values of urinary 8-OHdG and MDA and peripheral lymphocyte DNA strand breaks (which are biomarkers of oxidative stress) were significantly higher by 185%, 62%, and 97% in smokers than nonsmokers.
- Baseline values of SOD, GPX, and catalase (the principal antioxidant enzymes in plasma) were significantly lower by 15%, 10%, and 9%, respectively, in smokers than nonsmokers.
- At baseline, the serum α -tocopherol was comparable in both groups, possibly due to their general good health or young age (smoking-induced decreases in α -tocopherol appear more marked in older adults).
- After the almond intervention, serum α -tocopherol, SOD, and GPX increased significantly in smokers by 8.6%, 35%, and 16%, respectively, and 8-OHdG, MDA, and DNA strand breaks decreased significantly by 28%, 23%, and 34%.
- In smokers, after almond supplementation, the concentration of 8-OHdG remained significantly greater than in nonsmokers by 98%.

The authors note that the increase in serum α -tocopherol of 8.6% after almond intervention was smaller than the 19% increment observed by Jambazian et al.,¹ who found that 56 g per day of almonds for 4 weeks increased the level from 26.3 to 31.2 $\mu\text{mol/L}$ in healthy adults. The authors further note that the concentration of urinary 8-OHdG excretion in this study is consistent with results from some clinical interventions with vitamin C supplementation,² green tea,³ and red ginseng⁴ on oxidative DNA damage.

In summary, say the authors, "consuming a diet containing 84 g per day of almonds [about 70 almonds] for 4 weeks decreased oxidative stress in young male smokers. However, the effects of almonds on the antioxidant defense system and oxidative stress in nonsmokers remain to be explored." These results would suggest that the consumption of almonds can enhance antioxidant defenses and decrease biomarkers of oxidative stress in smokers.

—Shari Henson

References

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