Human health and nutrition




Avocado consumption increases neural lutein concentrations and improves cognitive function

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Lutein, a dietary carotenoid, is selectively taken up into neural tissue such as the macula and brain. Lutein concentrations in serum, macula (macular pigment, MP) and brain are related to better cognition. MP is a biomarker of lutein concentrations in brain. Avocados are a highly bioavailable source of lutein. This 6 month randomized, controlled trial tested the effects of daily intake of 1 medium avocado (AV, n=19) vs 1 medium potato or 1 cup of chickpeas (C, n=20) on serum lutein, MP density and cognition in healthy older adults (>50 yrs). Serum carotenoids were measured by HPLC. MP density, using heterochromatic flicker photometry, was used as a measure of lutein in neural tissue. A computerized assessment battery was used for measures of cognition (CANTAB). At baseline there were no significant differences between the groups. At 6 month, the AV group serum lutein concentrations significantly increased from baseline by 20% ($p<0.0005$) whereas the C group increased by 7% ($p<0.03$). At 6 months there was a significant increase in MP in the AV group ($p<0.001$). MP did not change from baseline in the C group. In the AV group the change in MP was significantly related to an improved spatial working memory ($p<0.009$) and problem approaching efficiency ($p<0.036$). No significant changes in cognition were observed in the C group. These data suggest that a dietary intervention with avocados to increase neural lutein concentrations is an effective dietary strategy for cognitive health. Support: Hass Avocado Board and USDA 58-1950-0-014.

The effect of a moderate fat diet with and without avocados on lipids and lipoprotein particle subclasses in overweight and obese adults

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Avocados are a nutrient dense food source of monounsaturated fatty acids (MUFA) that can be used to replace saturated fatty acids (SFA) in a diet to lower LDL cholesterol (LDL-C). Well-controlled studies are lacking on the effect of avocado consumption on cardiovascular disease (CVD) risk factors.

A randomized, cross-over, controlled feeding trial was conducted with 45 overweight or obese participants with baseline LDL-C in the 25-90th percentile. Three cholesterol-lowering diets (6-7% SFA) were fed (5 weeks each): a lower-fat diet (LF: 24% fat); two moderate fat diets (34% fat) provided similar foods and matched for macronutrients and fatty acids: the avocado diet (AV) included one fresh Hass avocado (136 g) per day, and the moderate fat diet (MF) mainly used high oleic acid oils to match the fatty acid content of one avocado. Compared to baseline, the reduction in LDL-C and non-high density lipoprotein (HDL) cholesterol on the AV diet (-13.5 mg/dL, -14.8 mg/dL) was greater ($p<0.05$) than the MF (-8.3 mg/dL, -8.9 mg/dL) and LF (-7.4 mg/dL, -4.8 mg/dL) diets. Furthermore, only the AV diet significantly decreased LDL particle number (LDL-P, -80.1 nmol/L, $p=0.0001$), small dense LDL cholesterol (LDL3+4, -4.1 mg/dL, $p=0.04$), and the ratio of LDL/HDL (-6.6%, $p<0.0001$) from baseline.

In conclusion, inclusion of one avocado per day as part of a moderate fat, cholesterol-lowering diet has additional LDL-C, LDL-P, and non-HDL-C lowering effects, especially for small, dense LDL. Our results demonstrate that avocados have beneficial effects on cardio-metabolic risk factors that extend beyond their heart-healthy fatty acid profile.

Avocado consumption is postively associated with intakes of key nutrients, fruit, vegetables, and discretionary oils in us adults: nhanes, 2001-2012

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The impact of consuming avocados on nutrient and food group intake was examined in adults using National Health and Nutrition Examination Survey 2001-2012 data (n=27,298; 51% males). Avocado consumers (n=612; 51% males) were defined as those consuming any amount of avocado (mean consumption 73.8±3.8g/d) using 24 hour recall data. Means, standard errors, and covariate adjusted linear regressions ($p<0.01$) were determined using appropriate sample weights. Avocado consumers had higher energy adjusted intakes of total fat (90.6±1.3 v 82.3±0.2 g); monounsaturated fat (36.2±0.7 v 30.1±0.1 g); polyunsaturated fat (19.4±0.4 v 17.8±0.1 g); dietary fiber (23.5±0.5 v 16.3±0.1 g); vitamins E (10.2±0.3 v 7.7±0.1 mg), K (159.5±9.7 v 102.5±1.9 mcg), and C (114.8±4.9 v 86.9±1.2 mg); folate (620.8±18.0 v 547.6±3.5 mcg); copper (1.6±0.04 v 1.3±0.01 mg); magnesium (346.3±5.7 v 296.6±1.4 mg); and potassium (3,243.0±49.7 v 2,732.3±10.7 mg); and lower intakes of total carbohydrates (251.4±3.5 v 265.3±0.7 g), added sugars (14.48±0.64 v 19.41±0.18 tsp eq), and sodium (3,393.4±57.7 v 3,637.8±9.6 mg) than non-avocado consumers. There was no difference in energy intake between avocado consumers and non-consumers. Avocado consumers also had higher intakes of total fruit (1.4±0.1 v 1.0±0.02 cup eq), total vegetables (2.3±0.1 v 1.6±0.01 cup eq), and discretionary oils (32.1±1.4 v 22.1±0.2 gm) and lower intakes of meat/poultry/fish (4.2±0.2 v 4.9±0.04 oz eq) and discretionary solid fats (36.8±1.4 v 41.7±0.2 gm) than non-avocado consumers. Avocado consumption was positively associated with nutrient intake and intake of fruit, vegetables, and discretionary oils. Support provided by Hass Avocado Board and the USDA

Avocado consumption is postively associated with diet quality and inversly associated with weight parameters in us adults: nhanes, 2001-2012

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The effect of consuming avocados on diet quality, weight parameters, and the risk of adiposity was examined in adults using National Health and Nutrition Examination Survey 2001-2012 data (n=27,298; 51% males). Avocado consumers (n=612; 51% males) were defined as those consuming any amount of avocado (mean consumption 73.8±3.8g/d) using 24 hour recall data. Means, standard errors, and covariate adjusted linear ($p<0.01$) and logistic regression ($p<0.01$) were determined using appropriate sample weights. Diet quality, measured using the Healthy Eating Index-2010 (HEI), was higher in avocado consumers than in non-consumers (57.5±0.8 v 48.2±0.2). Avocado consumers had higher totals for HEI component scores: total vegetables (0.9), greens and beans (0.5), total fruit (0.6), whole fruit (0.9), seafood and plant protein (0.8), and fatty acid ratio (1.2), and the three reverse-scored components: sodium (0.8), refined grains (0.7), and empty calories (2.9) than non-consumers. Avocado consumers had lower a mean weight (78.3±0.9 v 81.7±0.2kg), body mass index 27.3±0.8 v 28.5±0.1kg/m^2), and waist circumference (WC) (94.6±0.8 v 97.6±0.2cm); consumers had a lower percentage of those who were overweight or obese (59±0.03 v 67±0.01) and had an elevated WC (44±0.02 v 53±0.01). Avocado consumers were 33% (CI 0.48-0.95) less likely to be overweight or obese and 32% (CI 0.51-0.90) less likely to have an elevated WC than non-consumers. Avocado consumption was positively associated with overall diet quality, higher intake of fruits and vegetables, seafood and plant proteins, and a better fatty acid ratio; consumers were less likely to be overweight or obese or have an elevated WC. Support provided by Hass Avocado Board and the USDA.

Post-ingestive effects of avocados in meals on satiety and gastric hormone blood levels

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Food ingestion is a complex process involving biological and psychological determinants. Avocados are nutrient dense foods, with characteristics that may favorably impact energy balance. We evaluated if incorporating one half Hass avocado by addition or inclusion into lunch meal influences post-ingestive satiety and hormones response in overweight adults. Methods: In a cross-over fashion, 26 healthy subjects (mean BMI of 28.1) consumed 3 lunch test meals: Control (C); Avocado Inclusive (AI) a meal containing avocado matched with C for energy; and Avocado Added (AA) the C meal plus avocado. Blood samples obtained before and at 0.5, 1, 2 and 3h following lunch were assayed for insulin, ghrelin, leptin, GIP, glucagon-like peptide-1, and PYY. Visual analog scales (VAS) were administered at the same previous times to assess subjective feeling related to satiety. The area under the curve was computed for VAS and biological measures. We found significant differences in self-reported feelings of satisfaction and lesser desire to eat in the mixed model analysis. Compared to the C lunch, the AI and AA lunches increased satisfaction by 22% and 26% respectively, and decreased the desire to eat by 24% and 40% respectively. Compared to the AI lunch, blood insulin was higher after the C and AA lunches, leptin was also different for the AI and AA compared to control. Conclusion: The inclusion or addition of one half avocado to a lunch meal favorably increased satisfaction, and reduced the desire to eat over a subsequent 3 hour period in overweight adults. The biological changes in insulin and leptin related to avocado intake deserves further study, since may provide clues for energy balance and weight control.

Hass avocados enhance bioavailability and bioconversion of carotenoids from fruits and vegetables in humans

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Carotenoids provide health benefits both through their ability to act as provitamin A, and through their modulation of chronic disease processes. This class of lipophilic compounds is known to be poorly bioavailable, thus limiting bioactivity. However, lipid-rich dietary components, like Hass avocados, have the potential to enhance carotenoid bioavailability and bioconversion. Herein, we highlight work from our group demonstrating increased carotenoid bioavailability and providing new findings on the bioconversion in healthy humans, when foods are co-consumed with lipid-rich Hass avocados. We have shown that the consumption of either one-half (75 g) or one raw avocado (150 g) or an equivalent amount of avocado oil (24 g) with a meal rich in vegetables containing β-carotene, α-carotene, lutein and lycopene can increase absorption of those carotenoids by several fold. Separately, we have shown that human consumption of provitamin A carotenoids (β-carotene from a novel β-carotene rich orange tomato sauce, and β- and α-carotene from carrots) with avocados increased conversion to vitamin A, as measured by retinyl esters in the newly absorbed lipid-rich fraction of blood. Additionally, using newly developed methodologies in our laboratory, we were able to assess the vitamin A potential of α-carotene from carrots, in a meal consumed with avocados. The addition of avocado increased the production of vitamin A by several fold compared to a meal without avocado. In conclusion, the ability of avocados to improve carotenoid bioavailability and bioconversion has important implications for both delivering enhanced levels of carotenoids to the bloodstream and for enhancing vitamin A status, a nutrient whose deficiency is still prevalent in the developing world.

Avocado consumption lowers plasma oxidized low density lipoprotein and increases plasma antioxidants in overweight and obese adults

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Avocados are a nutrient dense source of monounsaturated fatty acids (MUFA) that are high in antioxidants. Our previous study showed that avocados have an additional LDL cholesterol (LDL-C) lowering effect beyond their MUFA content, especially on small, dense LDL particles, which are oxidized easily in vivo. However, clinical studies on the effect of avocados on oxidative stress are lacking. A randomized, cross-over, controlled feeding trial was conducted with 45 healthy, overweight or obese participants with baseline LDL-C in the 25-90th percentile. Three cholesterol-lowering diets (6-7% SFA) were fed (5 weeks each): a lower-fat diet (LF: 24% fat); two moderate fat diets (34% fat) provided similar foods and were matched for macronutrients and fatty acids: the avocado diet (AV) included one fresh Hass avocado (136 g) per day, and the moderate fat diet (MF) mainly used high oleic acid oils to match the fatty acid profile of one avocado. Compared to the baseline, only the AV diet decreased oxLDL (-7.0 U/L, -8.8%, p=0.0004) while the LF diet (-1.6 U/L p=0.1) and the MF diet (-3.2 U/L, p=0.2) did not affect oxidized-LDL significantly. Furthermore, only the AV diet increased plasma lutein by 68.7% from baseline (p<0.0001), and the increase in lutein was significantly different greater than the increase following the MF (21.1%, p=0.7) and LF (37.6%, p=0.1) diets. In conclusion, including one avocado per day into a heart-healthy diet lowers plasma oxidized LDL and increases lutein concentration. These beneficial effects are due to avocado bioactives rather than their fatty acid content.

Study of the properties of vitamins

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Riboflavin, cyanocobalamin and nicotinic acid are water-soluble B vitamins that play important roles in cell metabolism. They have a key role in the normal functioning of the brain and nervous system. B vitamins are widely used in medicine, in food industry, in production of cosmetics. The goals of this work include calorimetric determination of the standard thermodynamic functions of the B vitamins with the purpose of describing biochemical and industrial processes with its participation. The temperature dependences of heat capacity of riboflavin ($C_{17}H_{20}N_4O_6$), cyanocobalamin ($C_{63}H_{89}CoN_{14}O_{14}P$) and nicotinic acid ($C_5H_4N{-}COOH$) have been measured in the range from 7 to 330 K, from 6 to 343 K and from 5 to 346 K respectively. The heat capacity for all substances gradually increases with rising temperature and does not show any peculiarities. The experimental data were used to calculate standard thermodynamic functions, namely the heat capacity, enthalpy, entropy and Gibbs function, for the range from 0 to 330 K. The value of the fractal dimension D in the function of multifractal generalization of Debye's theory of the heat capacity of solids was estimated and the character of heterodynamics of structure was detected. In a calorimeter with a static bomb and an isothermal shield, the energies of combustion of the vitamins have been measured. The enthalpies of combustion ΔcH° and the thermodynamic parameters ΔfH°, ΔfS°, ΔfG° and of reactions of formation of the vitamins have been calculated. For the tested substances using differential scanning calorimetry were determined by the decomposition temperatures.

Hormones and their properties

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Hydrocortisone is a steroid hormone, which is produced by the zona fasciculata of the adrenal cortex. Hydrocortisone (or derivative form - hydrocortisone acetate with composition $C_{23}H_{32}O_6$) is used to treat people who lack adequate naturally generated cortisol. It is on the World Health Organization's List of Essential Medicines needed in a basic health system. The goals of this work include calorimetric determination of the standard thermodynamic functions of the hydrocortisone acetate with the purpose of describing biochemical and industrial processes with its participation. The energy of combustion, ΔcU, of hydrocortisone acetate was measured in a calorimeter (V-08) with a static bomb and an isothermal shield. The values are for the reaction: $C_{23}H_{32}O_6(cr) + 28{\bullet}O_2(g) \rightarrow 23{\bullet}CO_2(g) + 16{\bullet}H_2O(l)$. In brackets are given the physical states of reagents: (cr), crystalline; (g), gaseous; (l), liquid. The data on the enthalpy of combustion of the crystalline hydrocortisone acetate was used to estimate enthalpy of combustion and formation at $T = 298.15$K and $p = 0.1$MPa ($\Delta fHo(C_{23}H_{32}O_6) = -1307 \pm 12$ kJ·mol-1). On the basis of the obtained value, we calculated the thermal effect of industrial acylation of hydrocortisone for the first time.