Improving Insulin Sensitivity with a Whole Food, Plant-Based Diet

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NMDOH
NEW MEXICO DEPARTMENT OF HEALTH

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First things first, let's check in!

Please share in the chat:

- If you were the weather, what would be the forecast?

2

Second things second, let's set an intention!

Please share in the chat:

1. A new fruit, veg, or any other whole plant food (or fungus!) you'd like to try in 2021!

3

Time to Rock & Roll!

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Outline

- Type of fat (and where it is located) matters
  - Fat quantity and quality can have a big impact
- Fat-insulin connection
  - What causes insulin resistance?
- A century-worth of data
  - Improving insulin sensitivity with plants
- Putting it into practice
  - Tools for the refrigerator door

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Type of Fat Matters

(What are SAFA, MUFA, and PUFA anyway?)

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Type of Fat Matters

B. Vessby et al.: Dietary fat and insulin sensitivity

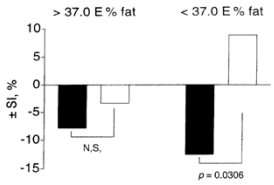

Fig. 1. Effects of a change of dietary fat quality on insulin sensitivity when related to total dietary fat intake during treatment

- Randomized, isocaloric SAFA and MUFA diets and insulin sensitivity
- Effect on serum lipids:
  - SAFA – Significant ↑ in serum cholesterol (+2.5%; p<0.05) & LDL (+4.1; P<0.01)
  - MUFA – Significant ↓ in serum cholesterol (-2.7%; p<0.05) & LDL (-5.1%; p<0.001)
  - SAFA & MUFA differences in serum cholesterol (p<0.001) and LDL (p<0.001)

Vessby et al. Substituting dietary saturated fat for monounsaturated fat impairs insulin sensitivity in healthy men and women: The KANWU study. Diabetologia (2001) 44: 312-319.

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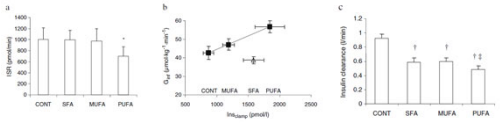
Type of Fat (Still) Matters



a. PUFA ↓ in glucose-stimulate insulin secretion
b. SFA induced insulin resistance.
   a. Insulin production did not increase to compensate for insulin resistance (possible beta cell impairment).
c. Insulin clearance reduced with consumption of all three emulsions

Xiao C, Giacca A, Carpentier A, Lewis GF. Differential effects of monounsaturated, polyunsaturated and saturate fat ingestion on glucose-stimulated insulin secretion, sensitivity and clearance in overweight and obese, non-diabetic humans. Diabetologia (2006) 49: 1371-1379.

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The Fat-Insulin Connection

(What Causes Insulin Resistance?)

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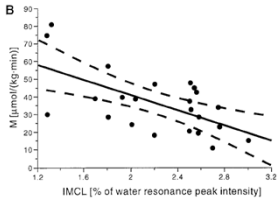
Intramyocellular Lipid & Insulin Sensitivity

- Inverse correlations:
  - IMCL and insulin sensitivity (r = -0.692, p = 0.0017)
  - Fasting plasma NEFA and insulin sensitivity (r = -0.54, p = 0.0267)
- IMCL not related to:
  - BMI
  - Age
  - Fasting plasma triglyerides
  - NEFA
  - Glucose
  - Insulin



Krssak M, Falk Petersen K, Dresner A, et al. Intramyocellular lipid concentrations are correlated with insulin sensitivity in humans: a 1H NMR spectroscopy study. Diabetologia. 1999;42(1):113-116.

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A Century-Worth of Data

(Improving Insulin Sensitivity with Plants)

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Dextrose Tolerance (1927!)

- 2 days on diets, then dextrose test
- Fat diet: olive oil, butter, mayo, 20% cream.
- Carbohydrate diet: sugar, candy, pastry, white bread, baked potatoes, syrup, rice, and oatmeal.
- Day 3: 1.75 g/kg D

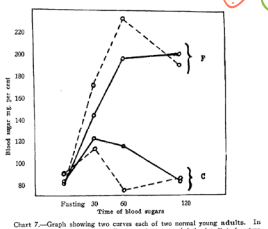

Chart 7.—Graph showing two curves each of two normal young adults. In one instance—the curves marked *F*—the students were fed the fat diet for two days prior to the test; in the other instance—the curves marked C—they were fed the carbohydrate diet. Similar lines represent the same subjects.

Sweeney JS. Dietary factors that influence the dextrose tolerance test: a preliminary study *The Archives of Internal Medicine*. 1927;40 (6):818-830.

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High Carb, High Fiber vs. Conventional Diabetic Diet

Control diet (avg 7 days):
- 45% CHO, 20% P, 37% Fat

HCF (avg 16 days):
- 70% CHO, 21% P, 9% Fat

To reduce confounding:
- Weight maintenance

Results:
- Avg insulin dose:
  - Control: 26 ± 3 units/day (mean ± SEM)
  - HCF: 11 ± 3 diet (p<0.001)

On HCF diet:
- Insulin discontinued:
  - 9 patients who started on 15-20 units/day
  - 2 patients who had begun on 32 units/day

Lipids:
- Control: 206 ± 10 mg/dL
- HCF: 147 ± 5 (p<0.001)
- No change in fasting serum triclycerides

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Dietary Phytochemical Index (DPI) and Prediabetes[1]

- **91% lower odds** of prediabetes when just over ½ kcal are healthy plant foods
- Bad news for Americans
  - DPI = Estimate of **17.6**

Table 4: Odds ratio and 95% confidence intervals for prediabetes across sex-specific quartiles of energy-adjusted dietary phytochemical index

Phytochemical index	Q1 (n=74) <16.47	Q2 (n=75) 16.47-28.13	Q3 (n=77) 28.14-52.45	Q4 (n=74) >52.45	*P* trend
Model 1					
OR (95% CI)	1.00	0.25 (0.12-0.52)	0.24 (0.11-0.49)	0.10 (0.04-0.21)	<0.001
P		<0.001	<0.001	<0.001	
Model 2					
OR (95% CI)	1.00	0.41 (0.16-1.01)	0.2 (0.11-0.75)	0.09 (0.03-0.25)	<0.001
P		0.05	0.01	<0.001	

Model 1=Crude, Model 2=Adjusted for BMI (kg/m²), physical activity (MET/min/week), education (years), total energy intake (kcal/day), dietary fiber (g/day), dietary carbohydrate (percentage of energy), fat (percentage of energy), and protein (percentage of energy). BMI=Body mass index, MET=Metabolic equivalent

1. Abshirini M, Mahaki B, Bagheri F, Siassi F, Koohdani F, Sotoudeh G. High intake of phytochemical-rich foods is inversely related to prediabetes: A case–control study. Int J Prev Med 2018;9:64.
2. Volpe R, Okrent AM. Assessing the Healthfulness of Consumers' Grocery Purchases. Department of Agriculture Economic Research Service; Washington, DC, USA: 2012. EIB-102.

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Brown Rice Vegan vs KDA Diet
(Korean Diabetic Association)

Vegan group (n = 46):
- -0.5% drop in A1c (p<0.01)

Conventional group (n = 47):
- -0.2 drop in A1c (p<0.05)

- p-for-interaction for time*group interaction = 0.017

Controlling for waist circumference:
- p-for-interaction for time*group interaction = 0.042

Controlling for mean energy intake:
- p-for-interaction for time*group interaction = 0.037

Lee YM, Kim SA, Lee IK, et al. Effect of a Brown Rice Based Vegan Diet and Conventional Diabetic Diet on Glycemic Control of Patients with Type 2 Diabetes: A 12-Week Randomized Clinical Trial. PloS one. 2016;11(6):e0155918.

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Brown Rice vs KDA: High Compliance: ≥ 9/10 points

Vegan group (n = 14):
- **-0.9**% drop in A1c

Conventional group (n = 37):
- **-0.3**% drop in A1c

- p-for-interaction for time*group interaction = **0.010**

Controlling for waist circumference:
- p-for-interaction for time*group interaction = **0.011**

Controlling for mean energy intake:
- p-for-interaction for time*group interaction = **0.013**

Lee YM, Kim SA, Lee IK, et al. Effect of a Brown Rice Based Vegan Diet and Conventional Diabetic Diet on Glycemic Control of Patients with Type 2 Diabetes: A 12-Week Randomized Clinical Trial. PloS one. 2016;11(6):e0155918.

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Vegan burger vs Pork burger

Couscous burger (V-meal):
- C: 52%, P: 11%, F: 37%

Pork burger (M-meal):
- C: 27%, P: 21%, F: 52%

In **both** groups: M-meal → greater increase in lipids (p<0.001)

In T2DM group (n = 50):
- M-meal produced (when compared to V-meal):
  - greater persistent PP hyperinsulinemia (p<0.001)
  - GIH impairment: Concentrations of glucose-dependent insulinotropic peptide (GIP), peptide tyrosine-tyrosine (PYY), and pancreatic polypeptide (PP) were significantly lower compared to the V-meal (p<0.001).
  - Greater lipoperoxidation – a process implicated in the production of oxidative stress (p<0.05).

Belinova L, Kahleova H, Malinska H, et al. Differential acute postprandial effects of processed meat and isocaloric vegan meals on the gastrointestinal hormone response in subjects suffering from type 2 diabetes and healthy controls: a randomized crossover study. PloS one. 2014;9(3):e107561.

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Vegetarian vs Conventional Diabetic Diet (Czech)

Experimental group (n = 37)
- ~60% CHO, 15% P, 25% fat, 1 serving low-fat yogurt

Control group (n= 37):
- 50% CHO, 20% P, <30% fat

Variables measured:
- Insulin sensitivity
- Volume of visceral and subcutaneous fat
- Oxidative stress

Kahleova H, Matoulek M, Malinska H, et al. Vegetarian diet improves insulin resistance and oxidative stress markers more than conventional diet in subjects with Type 2 diabetes. Diabetic medicine : a journal of the British Diabetic Association. 2011;28(5):549-559.

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Veg vs Conventional Continued

When compared to the control group over 24 weeks:

- Experimental group:
  - Demonstrated greater **insulin sensitivity** compared to the control group [30% (95% CI 24.5-39) vs. 20% (95% CI 14-25), p = 0.04]
  - Greater losses of both visceral (p = 0.007) and subcutaneous (p = 0.02) body fat
  - Adipokines: adiponectin (group * time p = 0.02), resistin (group * time p = 0.005), and leptin (group * time p = 0.05) all significantly improved
  - OX stress markers: plasma vitamin C levels (group * time p = 0.002), superoxide dismutase (group * time p < 0.001), and reduced glutathione (group * time p < 0.001) all improved significantly

Kahleova H, Matoulek M, Malinska H, et al. Vegetarian diet improves insulin resistance and oxidative stress markers more than conventional diet in subjects with Type 2 diabetes. *Diabetic medicine : a journal of the British Diabetic Association*. 2011;28(5):549-559.

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Low Fat Vegan vs ADA Diet

V group (n = 49):

- 75% CHO, 15% P, ~10% fat

Conv group (n = 50):

- 15-20% P, <7% SFA, 60-70% CHO & MUFA

Intention-to-treat analysis (no regard to Rx changes):

- Changes in HbA1c from 0-74 wks (or last available) were -0.34% (V) and -0.14% drop (Conv) (p = 0.43)

Controlling for Rx changes:

- HbA1c: -0.40% (V) and +0.01% (Conv) (p = 0.03)
- V group: Total (p = 0.01), LDL (p = 0.03), and non-HDL (p = 0.02) cholesterol compared to Conv

Barnard ND, Cohen J, Jenkins DJ, et al. A low-fat vegan diet and a conventional diabetes diet in the treatment of type 2 diabetes: a randomized, controlled, 74-wk clinical trial. *Am J Clin Nutr*. 2009;89(5):1588S-1596S.

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Putting it into Practice!

(Practical Tools for the Refrigerator Door!)

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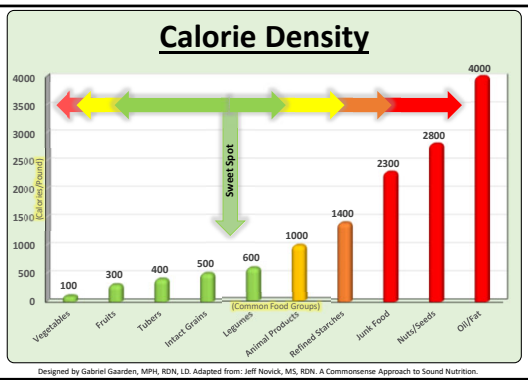
Calorie Density



Designed by Gabriel Gaarden, MPH, RDN, LD. Adapted from: Jeff Novick, MS, RDN. A Commonsense Approach to Sound Nutrition.

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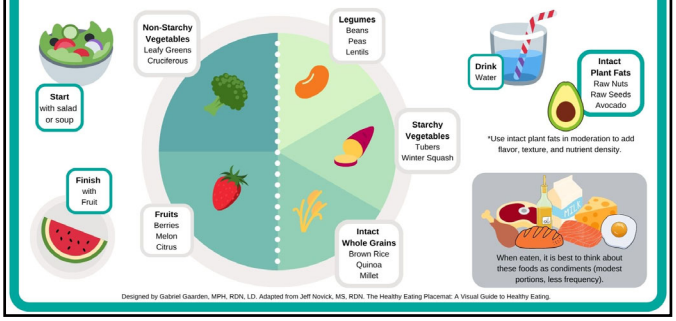
Optimize Your Placemat

To optimize health and body weight, use the 50/50 method! Aim for a visual volume of about 50% fruit/veg & 50% intact starch.



Designed by Gabriel Gaarden, MPH, RDN, LD. Adapted from Jeff Novick, MS, RDN. The Healthy Eating Placemat: A Visual Guide to Healthy Eating.

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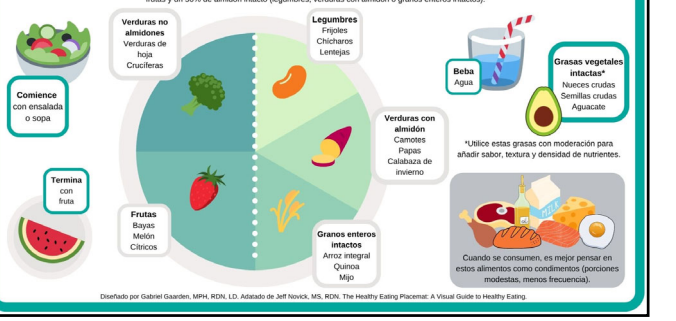
Optimice su mantel individual

Para optimizar la salud y el peso corporal, utilice el método 50/50. Intente conseguir un volumen visual de aproximadamente un 50% de verduras o frutas y un 50% de almidón intacto (legumbres, verduras con almidón o granos enteros intactos).



Diseñado por Gabriel Gaarden, MPH, RDN, LD. Adatado de Jeff Novick, MS, RDN. The Healthy Eating Placemat: A Visual Guide to Healthy Eating.

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Questions, Comments?
(Bring them on!)
Thank you for your participation!
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