Vegetarian Diets for Blood Lipid Management: An Eco-Atkins Perspective

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Support & Conflicts

Support:
• Agri-Food and Agriculture Canada
• Canadian Institutes of Health Research
• Solae

Conflicts of Interest:
• Unilever
• Barilla
• Loblaws Companies Limited
• Kelloggs
• Almond Board of California
• California Strawberry Commission
• Number of nutraceutical and pharmaceutical companies
DIETARY CHANGES WITH PROSPERITY

Traditional, Developing Countries

Modern, Developed Countries
Obesity Trends* Among U.S. Adults
BRFSS, 1990
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 1995
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2000

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2005

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Obesity Trends* Among U.S. Adults
BRFSS, 2010
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Number and Percentage of U.S. Population with Diagnosed Diabetes, 1958-2009

Metabolic Syndrome (↑Waist Circ, dyslipidemia, ↑BP, dysglycemia, ↑inflammation)

Diabetes

CHD
The results of an evidence-based review showed that a plant-based diet is associated with:

- lower risk of death from ischemic heart disease
- lower LDL cholesterol levels and blood pressure
- reduced rates of hypertension
- reduced rates of type 2 diabetes

Position of the American Dietetic Association: Vegetarian Diets

• People who follow plant-based diets tend to have a lower body mass index and lower overall cancer rates

• Risk of chronic disease is reduced by a lower intake of saturated fat and cholesterol and a higher intake of fruits, vegetables, whole grains, nuts, soy products, fiber and phytochemicals

Slide courtesy of Karmeen Kulkarni
Serum Lipid Response to a Diet Very High in Fiber From Vegetables and Fruit (Simian Diet)

- Low-fat therapeutic diet (NCEP Step 2)
  low-fat dairy, white rice, potato, fruit & vegetables (5 servings/d)

- High-fiber starch-based (Neolithic)
  low-fat yogurt, whole grains, lentils, fruit & vegetables (5 servings/d)

- High-fiber vegetable-based (Simian)
  63 servings/d fruit & vegetables, nuts (almonds and hazelnuts)

Jenkins DJ, Kendall CW et al. Metabolism 2001
## Daily Intakes of Vegetable Protein, Fiber, Phytosterols & Nuts

<table>
<thead>
<tr>
<th></th>
<th>NCEP Step 2</th>
<th>High-Fiber Starch-Based</th>
<th>High-Fiber Vegetable-Based Simian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable Protein (g/d)</td>
<td>28</td>
<td>64</td>
<td>93</td>
</tr>
<tr>
<td>Total Dietary Fiber (g/d)</td>
<td>26</td>
<td>46</td>
<td>143</td>
</tr>
<tr>
<td>Phytosterols (g/d)</td>
<td>0.3</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Nuts (almonds &amp; hazelnuts) (g/d)</td>
<td>0</td>
<td>0</td>
<td>70</td>
</tr>
</tbody>
</table>

Jenkins DJ, Kendall CW et al. Metabolism 2001
Serum Lipid Response to a Diet Very High in Fiber From Vegetables and Fruit (Simian Diet)

Jenkins DJ, Kendall CW et al. Metabolism 2001

LDL-cholesterol

% Change from Baseline

Week 0 1 2

LDL:HDL-cholesterol

% Change from Baseline

Week 0 1 2

NCEP Step II
Neolithic
Simian

Jenkins DJ, Kendall CW et al. Metabolism 2001
The Simian Diet

5.5 kg food in
The Simian Diet

5.5 kg food in

1.0+ kg feces out

1g bile acids
Current FDA Health Claims for CHD Risk Reduction

**Vegetable Proteins**
- Soy

**Viscous Fibers**
- Oat β-glucan
- Barley β-glucan
- Psyllium

**Phytosterols**
- Sterols
- Stanols

**Nuts**
Study Foods: Readily available in supermarkets.

Nuts: ~30 g/d
   almonds

Viscous Fiber: ~20 g/d
   oats, barley, psyllium, legumes, eggplant, okra

Vegetable Protein: ~80 g/d (50% soy)
   soy, beans, chick peas, lentils

Plant Sterols: ~2 g/d
   plant sterol margarine

Jenkins DJ, Kendall CW et al. Metabolism 2002
Dietary Portfolio: Changes in LDL-C

Jenkins DJ, Kendall CW et al. JAMA 2003
Dietary Portfolio
Changes in C-Reactive Protein

Jenkins DJ, Kendall CW et al. JAMA 2003
Mean ± SE percentage change in LDL-C and HDL-C at end of each year (n = 30). * and ** represent significant differences from baseline and year 1 respectively (P < 0.01).
Mean ± SE percentage change in ratio of Total-C to HDL-C at end of each year (n=30). * represents significant difference from baseline (P < 0.001).
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- The surprising (and startling) truth

FREE Carb Counter Inside

DR. ATKINs’ AGE-DEFYING DIET REVOLUTION

THE NEW YORK TIMES BESTSELLER

DR. DEAN ORNISH’S PROGRAM FOR REVERSING HEART DISEASE

The Only System
Scientifically Proven to Reverse Heart Disease
Without Drugs or Surgery

The program based on the landmark research just published in the Journal of the American Medical Association

The Only System
Scientifically Proven to Reverse Heart Disease
Without Drugs or Surgery

5 EASY STEPS to OUTSMART YOUR FAT INSTINCT

THE PRITIKIN WEIGHT LOSS BREAKTHROUGH

Robert Pritikin

The Pritikin Weight Loss Breakthrough

5 EASY STEPS to OUTSMART YOUR FAT INSTINCT

Robert Pritikin
Diet and Weight Loss

Diet and Serum Lipids

LDL-Cholesterol

At 12 months, P = 0.49
Overall Diet Group x Time, P = 0.26

## Low Carbohydrate Diet and LDL-C

<table>
<thead>
<tr>
<th>Authors</th>
<th>Duration</th>
<th>LDL Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volek et al, 2000</td>
<td>8 wks</td>
<td>↑ LDL</td>
</tr>
<tr>
<td>Foster et al, 2003</td>
<td>52 wks</td>
<td>↑ LDL / ↔ LDL</td>
</tr>
<tr>
<td>Volek et al, 2003</td>
<td>4 wks</td>
<td>↑ LDL</td>
</tr>
<tr>
<td>Samaha et al, 2003</td>
<td>24 wks</td>
<td>↔ LDL</td>
</tr>
<tr>
<td>Meckling et al, 2004</td>
<td>10 wks</td>
<td>↔ LDL</td>
</tr>
<tr>
<td>Stern et al, 2004</td>
<td>52 wks</td>
<td>↔ LDL</td>
</tr>
<tr>
<td>Schaefer et al, 2005</td>
<td>52 wks</td>
<td>↑ LDL / ↔ LDL</td>
</tr>
<tr>
<td>Noakes et al, 2006</td>
<td>12 wks</td>
<td>↑ LDL</td>
</tr>
</tbody>
</table>
Vegetable Protein and Fat
Nurses’ Health Study:
Low-CHO-Diet Score and Risk of CHD

Eco-Atkins
Animal → Vegetable

- Animal protein → vegetable protein
  - Mainly from soy, gluten (seitan) and nuts
- Animal fat → vegetable oil
  - tree nuts, avocado
  - olive and canola oils (high MUFA)
- Promotion of weight loss
Objective

To assess the effectiveness of a low carbohydrate, high protein vegan based diet on body weight and metabolic risk factors (e.g. blood lipids, CRP) under first metabolic and then real-world conditions.
**Study Design**

2-phase randomized controlled parallel study

- **Week:** 0, 2, 4, 8, 12, 16, 20, 24, 28

**Therapeutic Diet**
- 1 month
- **Metabolic**
- **Ad Libitum**

**High Protein Vegan Diet**
- 6 months

60% of energy requirements (Harris Benedict Equation).

- **A** = Anthropometrics, symptom diaries, exercise logs
- **B** = Blood
- **G** = Breath Gases
- **U** = 24h Urine
- **7** day food record
Volunteers

Subject Characteristics

• 50 overweight hyperlipidemic subjects randomized
  – 44 subjects (18M, 26F) completed metabolic phase
  – 23 subjects (9M, 14F) completed ad-libitum phase

• Mean age: 56.9±7.3y; range (30-76 y)

• BMI: 30.8±2.6 kg/m²; range (25.7-35.9)

• Baseline LDL: 4.07±1.21 mmol/L
Study Foods

All study foods readily available in supermarkets.

<table>
<thead>
<tr>
<th>Low Fat Control Diet</th>
<th>High Protein Vegan Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Viscous Fiber</td>
<td>Viscous Fiber</td>
</tr>
<tr>
<td>Whole wheat bread, bran flakes, wheat crackers, celery,</td>
<td>Oat bran cereal, barley, eggplant, okra</td>
</tr>
<tr>
<td>tomato</td>
<td></td>
</tr>
<tr>
<td>Dairy &amp; Egg Protein</td>
<td>Vegetable Protein</td>
</tr>
<tr>
<td>Skim milk, fat-free cheese &amp; yogurt, egg substitute, egg</td>
<td>Soy, seitan (wheat)</td>
</tr>
<tr>
<td>whites</td>
<td></td>
</tr>
<tr>
<td>Other Carbohydrates</td>
<td>Nuts</td>
</tr>
<tr>
<td>noodles/pasta</td>
<td>Almond, hazelnut, pecan, cashew, macadamia, pistachio</td>
</tr>
</tbody>
</table>
## Nutrient Profiles of Prescribed Control and Test Diets

(based on 2000 kcal diet)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>High CHO (Control) Diet</th>
<th>Low CHO (Test) Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal/d)</td>
<td>2001</td>
<td>2002</td>
</tr>
<tr>
<td>Total Protein (g/d)</td>
<td>82.2 (16.4)</td>
<td>152.3 (30.4)</td>
</tr>
<tr>
<td>Soy Protein (g/d)</td>
<td>0</td>
<td>34.5 (6.9)</td>
</tr>
<tr>
<td>Available Carbohydrate (g/d)</td>
<td>290.7 (58.3)</td>
<td>130.3 (26.2)</td>
</tr>
<tr>
<td>Total Dietary Fiber (g/1000kcal)</td>
<td>21.1</td>
<td>28.8</td>
</tr>
<tr>
<td>Total Fat (g/d)</td>
<td>56.2 (25.3)</td>
<td>96.6 (43.4)</td>
</tr>
<tr>
<td>SFA (g/d)</td>
<td>10.1 (4.6)</td>
<td>14.2 (6.4)</td>
</tr>
<tr>
<td>MUFA (g/d)</td>
<td>18.4 (8.3)</td>
<td>56.6 (25.5)</td>
</tr>
<tr>
<td>PUFA (g/d)</td>
<td>21.2 (9.5)</td>
<td>21.1 (9.5)</td>
</tr>
<tr>
<td>Dietary Cholesterol (mg/1000kcal)</td>
<td>27.5</td>
<td>0</td>
</tr>
</tbody>
</table>

Expressed as % of energy.
Body Weight

% change from baseline

Weeks

Completers

Low Fat Control Diet

High Protein Vegan Diet

Metabolic
P = 0.986

Ad Libitum
P = 0.002
Body Weight

-14 -12 -10 -8 -6 -4 -2 0 2 4 8 12 16 20 24 28

% change from baseline

Weeks

0 2 4 8 12 16 20 24 28

Low Fat Control Diet
High Protein Vegan Diet

Metabolic
P = 0.979

Ad Libitum
P = 0.004

ITT-LOCF
LDL-Cholesterol

Weeks

% change from baseline

Completers

Metabolic

P = 0.001

Ad Libitum

P < 0.001

Low Fat Control Diet

High Protein Vegan Diet
LDL-Cholesterol

Weeks

% change from baseline

Low Fat Control Diet

High Protein Vegan Diet

P = 0.001

Metabolic

Ad Libitum

P = 0.001

ITT-LOCF

Weeks

0 2 4 8 12 16 20 24 28
TChol:HDL

% change from baseline

Weeks

Low Fat Control Diet
High Protein Vegan Diet

ITT-LOCF

Metabolic
P = 0.003

Ad Libitum
P = 0.001
1) Plant based diets may have advantages in reducing CHD risk when used in low carbohydrate Atkins-like weight loss diets.

2) Caloric restriction, exercise and moderation in all things remain the foundations for weight loss and health to which plant based diets may make a significant contribution.
Are Carbohydrates Bad?
Relationship of saturated fat intake to Coronary Heart Disease Before 1970

Seven Countries Study. Relation between sample average dietary fatty acids and sample 10-year coronary mortality in 16 cohorts. Reconstructed from published data.

US: US Railroad, United States; EF: East Finland, Finland; WF: West Finland, Finland; ZU: Zutphen, The Netherlands; CR: Crevalcore, Italy; MO: Montegiorgio, Italy; RR: Rome Railroad, Italy; DA: Dalmatia, Croatia, former Yugoslavia; SL: Slavonia, Croatia, former Yugoslavia; VK: Velika Krsna, Serbia, former Yugoslavia; ZR: Zrenjanin, Serbia, former Yugoslavia; BE: Belgrade, Serbia, former Yugoslavia; KT: Crete, Greece; CO: Corfu, Greece; TA: Tanushimar, Japan; UB: Ushibuka, Japan

Mancini and Stamler; Nutr Metab Cardiovasc Dis (2004) 14:52-57
(Keys A Circulation (1970) 41 (Suppl. 1): 1-211)
Relationship of saturated fat intake to Coronary Heart Disease

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Risk Ratio IV, Random, 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary Heart Disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shekelle et al(17)</td>
<td>1.11 [0.91, 1.36]</td>
<td>1981</td>
</tr>
<tr>
<td>McGee et al(9)</td>
<td>0.86 [0.67, 1.12]</td>
<td>1984</td>
</tr>
<tr>
<td>Kushi et al(13)</td>
<td>1.33 [0.95, 1.87]</td>
<td>1985</td>
</tr>
<tr>
<td>Posner et al(16)</td>
<td>0.92 [0.68, 1.24]</td>
<td>1991</td>
</tr>
<tr>
<td>Goldbourt et al(35)</td>
<td>0.86 [0.56, 1.35]</td>
<td>1993</td>
</tr>
<tr>
<td>Fehily et al(28)</td>
<td>1.57 [0.56, 4.42]</td>
<td>1994</td>
</tr>
<tr>
<td>Ascherio et al(4)</td>
<td>1.11 [0.87, 1.42]</td>
<td>1996</td>
</tr>
<tr>
<td>Esrey et al(6)</td>
<td>0.97 [0.80, 1.18]</td>
<td>1996</td>
</tr>
<tr>
<td>Pietinen et al(15)</td>
<td>0.93 [0.60, 1.44]</td>
<td>1997</td>
</tr>
<tr>
<td>Boniface et al(5)</td>
<td>1.37 [1.17, 1.60]</td>
<td>2002</td>
</tr>
<tr>
<td>Jakobsen et al(8)</td>
<td>1.03 [0.66, 1.60]</td>
<td>2004</td>
</tr>
<tr>
<td>Oh et al(33)</td>
<td>0.97 [0.74, 1.27]</td>
<td>2005</td>
</tr>
<tr>
<td>Tucker et al(18)</td>
<td>1.22 [0.31, 4.77]</td>
<td>2005</td>
</tr>
<tr>
<td>Xu et al(10)</td>
<td>1.91 [0.31, 11.84]</td>
<td>2006</td>
</tr>
<tr>
<td>Leosdottir et al(14)</td>
<td>0.95 [0.74, 1.21]</td>
<td>2007</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>1.07 [0.96, 1.19]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.02; Chi² = 25.54, df = 15 (P = 0.04); I² = 41%
Test for overall effect: Z = 1.22 (P = 0.22)

FIGURE 2. Risk ratios and 95% CIs for fully adjusted random-effects models examining associations between saturated fat intake in relation to coronary heart disease. SAT, saturated fat intake; IV, inverse variance.

Glycemic Index

Low vs. High GI Foods:

FIGURE 1. Hypothetical effect of feeding diets with a low (A) or high (B) glycemic index on gastrointestinal glucose absorption and post-prandial blood glucose.
Blood Glucose Increments after Spaghetti, White and Wholemeal Bread (n=9)

Jenkins et al. Diab Care 1983;6:155-9
Glycemic Load and Cereal Fiber Intake in Women And Risk of Type II Diabetes (75,000 Nurses over 10y)

Salmeron et al. JAMA 1997;277:472-7
GI and HDL-C

Relation between HDL-cholesterol concentration and glycaemic index in men and women.
Glycemic Load and CRP at High and Low BMI

Hazard Ratios for Myocardial Infarction for Danish Men (N= 25,149 for 12 y)

<table>
<thead>
<tr>
<th>Tertiles (Glycemic Index of Carbohydrates)</th>
<th>Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbs with low GI</td>
<td>0.83</td>
</tr>
<tr>
<td>Carbs with medium GI</td>
<td>1.08</td>
</tr>
<tr>
<td>Carbs with high GI</td>
<td>1.34</td>
</tr>
</tbody>
</table>

Jakobsen et al AJCN (2010)
Risk of Coronary Heart Disease in Italian Women on High and Low GI Carbohydrate intake (n=32,578 for 7.9 y)

Quartile of Carbohydrate from High GI food

Sieri S et al. Arch Intern Med 2010;170;640-647
Low vs High GI Diet: a Meta-Analysis
% Difference in Glycated Proteins

Mean % difference in 14 studies = -7.4% (CI -8.8 to -6.0%)

Brand-Miller et al, Diabetes Care 2003;26:2261-67
Some low GI foods

- Steel cut oats
- Barley
- Pasta
- Parboiled rice
- Lentils
- Chick peas
- Dried beans
- Pumpernickel breads
- Pita Break Finland Rye
- Little Stream Quinoa
HbA1c on High Cereal Fiber and Low Glycemic Index Diets

Low Glycemic Index Diets and Diabetes Control (n=210)


P = 0.022

Fasting glucose (mg/dL)

Week

Low Glycemic Index Diets and Diabetes Control \((n=210)\)

Low Glycemic Index Diets and Diabetes Control (n=210)

Conclusion

• Consuming low GI CHO may have advantages in diabetes prevention, treatment and complications reduction (including CHD)

• The nature of the dietary carbohydrate in the diet and the adipocity of a population may alter the relative atherogenicity of dietary saturated fatty acids
Future thoughts

- Use more plant foods
- Use more nuts and plant based oils
- Recommend temperate fruits as snacks (an apple a day, berries for blood pressure)
- Use soy as a protein source
Acknowledgements

Dr. David JA Jenkins
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