Impact of Low vs. High Carbohydrate Diets on Fasting Fatty Acid and Inflammatory Marker Concentrations

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INTRODUCTION

Obesity, imbalances in circulating omega-6 (n-6) and omega-3 (n-3) fatty acid concentrations, and high dietary saturated fat intake are associated with systemic inflammation. One strategy to reduce inflammation associated with obesity is through dietary interventions, like low-carbohydrate (LC) and high- carbohydrate (HC) diets, that result in weight loss. Although associated with greater weight loss, LC diets may exacerbate inflammation because of their high fat content.

OBJECTIVES

Dietary data and fasting blood samples obtained as part of a six-week randomized controlled feeding study of *ad lib* LC and HC diets were used to:

- Measure changes in circulating concentrations of saturated, n-6, and n-3 fatty acids and the inflammatory markers, interleukin-6 (IL-6) and C-reactive protein (CRP)
- Determine the correlation between changes in circulating fatty acid concentrations and changes in inflammatory marker concentrations

STUDY DESIGN & METHODS

INCLUSION CRITERIA

- Healthy, weight stable adults
- BMI: 30-50 kg/m²
- Willingness to eat either a LC or HC diet and to stop taking dietary supplements

EXCULSION CRITERIA

- Major debilitating mental or physical illness
- Renal, hepatic or gallbladder disease
- Diabetes or heart disease
- Food allergies/ intolerances/restrictions

DIETARY, BLOOD SAMPLE & STATISTICAL ANALYSES

- Diets were analyzed using ProNutra (Viocare, Princeton, NJ) and Nutrition Data System for Research (NDSR 2008, Minneapolis, MN)
- Plasma fatty acid concentrations were measured by GC/MS
- Serum IL-6 was measured by ELISA
- Plasma CRP was measured by immunoassay
- Differences within and between diet groups were measured using two-tailed nonparametric Wilcoxon sign rank and rank sum tests
- Correlations between changes in circulating fatty acid and inflammatory marker concentrations were determined after adjusting for weight loss

Table 1. Subject Characteristics at Baseline

Characteristic	LC Diet (n=10)	HC Diet (n=13)
Male/Female	1/9	3/10
Caucasian/Other	6/4	10/3
Age (y)	46 8	48 11
Weight (kg)	103 13	99 14
BMI (kg/m²)	37 5	35 5

Mean SD

Figure 1. Energy and Macronutrient Composition of Research Diets

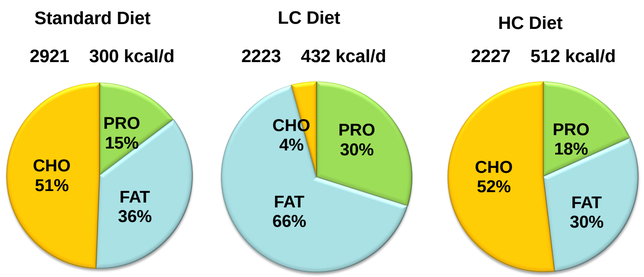


Table 2. Fatty Acid Content of Research Diets

Dietary Variables	Standard Diet (n=23)	LC Diet (n=10)	HC Diet (n=13)
Saturated Fatty Acids (g)	37 7	66 14	17 5
n-6 Fatty Acids (g)	25 6	17 3	19 5
n-3 Fatty Acids (g)	3 1	3 0.4	2 0.5
n-6/n-3 Fatty Acid Ratio	9 5	6 0.3	9 0.8

Figure 2. Change in Body Weight

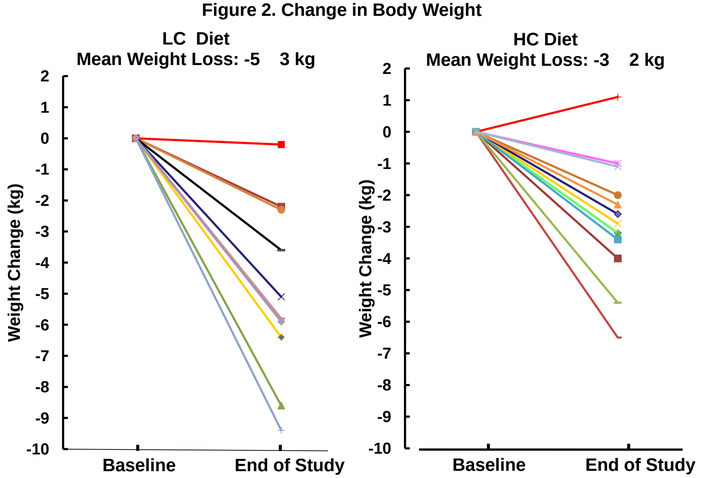
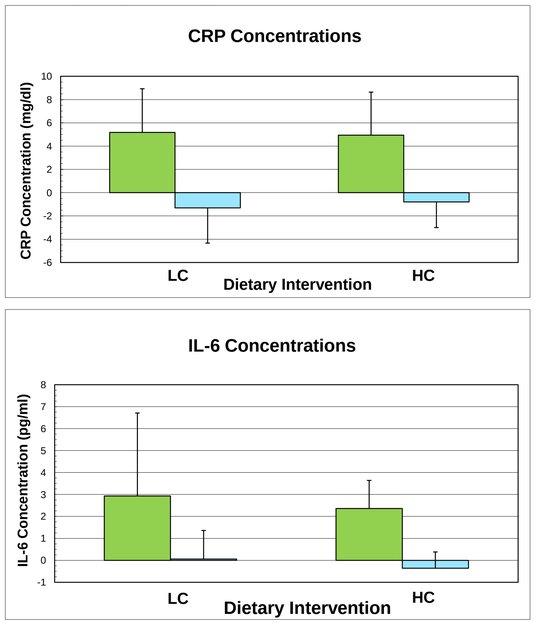


Table 3. Change in Fasting Plasma Fatty Acid Concentrations

Plasma Fatty Acids	Diet	Baseline	Change
Saturated Fatty Acids (µmol/L)	LC	2320 2456	-599 906
	HC	1432 435	-260 281
n-6 Fatty Acids (µmol/L)	LC	2043 283	190 512
	HC	2014 778	336 706
n-3 Fatty Acids (µmol/L)	LC	360 113	35 99
	HC	339 151	177 283
n-6/n-3 Fatty Acid Ratio	LC	6 2	-0.2 2
	HC	6 1	-1 1*

Mean SD; shaded cells indicate significant within groups differences from baseline; * p<0.01 between groups

Figure 3. Baseline (Green) and Change From Baseline (Blue) in Fasting CRP and IL-6 Concentrations



Mean SD

Table 4. Correlations Between Change in Fatty Acid and Inflammatory Marker Concentrations Adjusted for Weight Loss

Change in Plasma Fatty Acids	Diet	Change in CRP (mg/L) Corr. Coeff.	P	Change in IL-6 (pg/mL) Corr. Coeff.	P
Saturated Fatty Acids (µmol/L)	LC	-0.07	0.9	0.3	0.4
	HC	0.7	0.01	0.4	0.2
n-6 Fatty Acids (µmol/L)	LC	-0.3	0.3	-0.08	0.8
	HC	0.4	0.1	0.2	0.5
n-3 Fatty Acids (µmol/L)	LC	-0.6	0.05	-0.07	0.9
	HC	0.3	0.2	0.3	0.3
n-6/n-3 Fatty Acid Ratio	LC	0.4	0.3	0.1	0.7
	HC	0.2	0.6	0.1	0.7

Corr. Coeff.= correlation coefficient.

SUMMARY

1. Plasma saturated fatty acid concentrations were significantly lower after the LC and HC diets, however, changes from baseline were not significantly different between groups.
2. Plasma n-3 fatty acid concentrations were significantly higher and ,as a result, the n-6/n-3 fatty acid ratio was significantly lower after the HC diet but not the LC diet.
3. Circulating CRP and IL-6 concentrations did not change significantly with weigh loss after either diet.
4. The change in saturated fatty acid concentration was directly correlated to the change in CRP concentration after the HC diet. Conversely, the change in n-3 fatty acid concentration was indirectly correlated to the change in CRP after the LC diet.

CONCLUSIONS

During active weight loss induced by LC and HC diets, changes in fasting saturated, n-6 and n-3 fatty acids, and IL-6 and CRP concentrations were not different despite stark differences in dietary macronutrient composition.

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