

**Report on Benefits of Strawberries - Long-term
Study
Health Research and Study Center (HRSC), Los Altos,
California
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Laboratories: Unilab (San Jose, CA), Pacific
Biometrics (Seattle, WA).

Background

The purpose of the study was to determine the health benefits of strawberries in healthy human subjects. The main focus of this pilot study was on the possible effects of strawberries on homocysteine, folate and C-reactive protein (CRP) levels. CRP is a general marker of inflammation, recently become the focus of much research, and appears to be associated with risk of future myocardial infarction, stroke, peripheral vascular disease and cardiovascular death, even in apparently healthy populations.

Subjects

Twenty healthy adults, all residents of the San Francisco Bay area, participated in the study. There were 7 males and 13 females, aged 23-91 years (mean age 53 years). Because of the limited budget and the deadline for the completion of the study, there was no screening for the blood values chosen for testing. Baseline standard blood chemistries were run to insure the subjects were healthy, and were given to them at the end of the study (Unilab, San Jose, CA). Of the 20 subjects who participated, 18 completed the study, 7 males and 11 females. One subject moved out of the area and the other was absent during the last week of the study, and

could not give her blood sample on time. All subjects signed a consent form and a standard subjects' Bill of Rights.

Study Design

After the baseline blood measurements, the subjects consumed one serving of strawberries 6 days a week (7 days if possible) for 4 weeks. A serving of strawberries comprised about 8 medium California strawberries. Fresh strawberries were picked up by subjects weekly at HRSC to insure freshness. Participants were asked not to change their typical diet or their supplement routine. In addition, the participants were asked to fill out a weekly questionnaire on bowel function, evaluating frequency, amount, effort and consistency of stools, as well as laxative or stool softener use.

The main blood measurements taken were homocysteine, folate, and CRP - at the beginning, and again at the end of the study. Total serum cholesterol was measured as a secondary measurement. The subjects were asked to consume their serving of strawberries in the last meal prior to the final blood draw. The tests were performed by Pacific Biometrics Laboratories (Seattle, WA), and Unilab (San Jose, CA). To ensure that baseline and end of study data could be properly compared, plasma samples were frozen at about -70°C at Pacific Biometrics for the homocysteine, folate, and CRP tests.

Data Analysis

The results of the plasma measurements are described as mean \pm standard deviation (SD). Non-parametric statistics (Wilcoxon signed rank test) were used to compare the changes between the beginning and end values of the three parameters analyzed. In the analysis of CRP one subject was excluded because of abnormal baseline value, indicating inflammation.

Results

After four weeks of daily strawberry consumption, no significant changes were observed in plasma homocysteine levels and a small non-significant decrease ($P < 0.1$) was observed in CRP. However, there was a statistically significant increase of 66% in folate levels ($P < 0.001$) (see Table 1 and Figures 1 and 2).

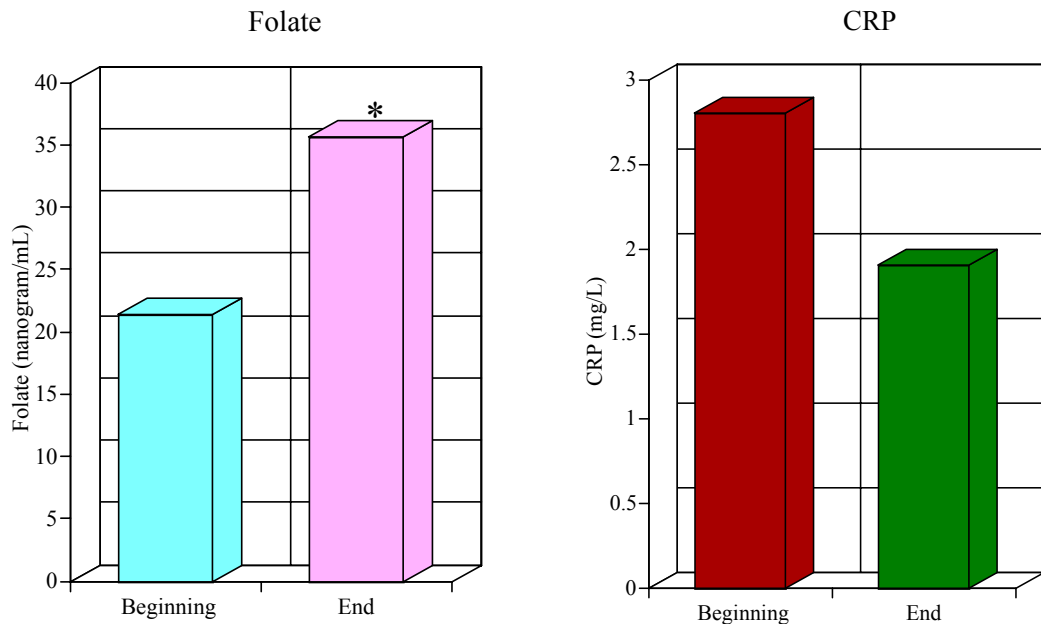
The review of the bowel function questionnaires revealed that 8 participants experienced some increase in stool frequency, 3 participants reported some improvement in effort to eliminate stools, 4 people reported softer stools and 3 people who took a laxative before the study, stopped while they were consuming strawberries.

Table 1. Homocysteine, folate, and C-reactive proteins (CRP) at beginning and end of study (mean \pm SD).

<u>Parameter</u>	<u>Beginning</u>	<u>End</u>	<u>Change</u>
Homocysteine($\mu\text{mol/L}$)	8.7 \pm 4.4	8.9 \pm 4.4	0.2 \pm 1.4
Folate (ng/mL)	21.4 \pm 7.8	35.6 \pm 12.6	14.2 \pm 10.1*
CRP (mg/L)	2.8 \pm 2.8	1.9 \pm 1.9	- 0.9 \pm 2.3

*statistically significant ($P < 0.001$).

Figures 1 and 2. Mean folate and CRP levels at the beginning



and end of the study.

* significantly different from beginning ($P < 0.001$).

Discussion

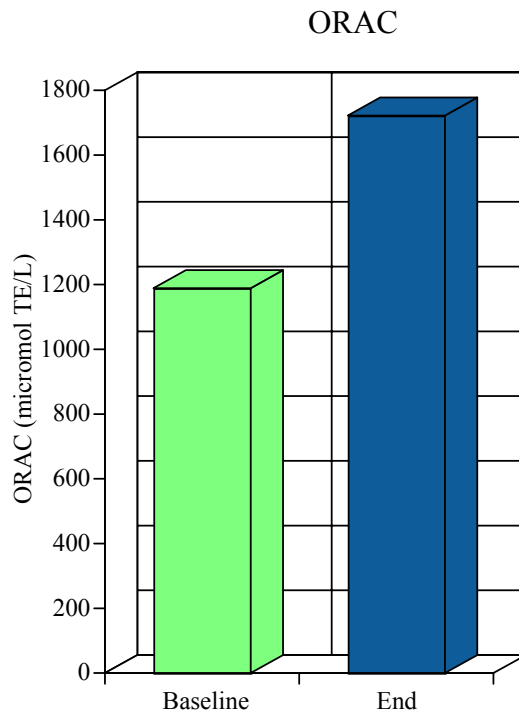
Daily consumption of a daily serving of strawberries for four weeks resulted in a statistically significant increase in folate levels in 18 healthy men and women. However, the levels of homocysteine and CRP remained unchanged. This can be explained by the fact that the study design did not include screening for participants for high levels of these parameters at baseline, which were well within the normal ranges.

In addition, it is interesting to note that for some people, strawberries may improve some aspects of bowel function (increased frequency and softer consistency, decreased effort of elimination), even to the point of stopping the use of laxatives.

Addendum

Oxygen Radical Absorbance Capacity (ORAC), a measure of the level of antioxidants present in the plasma, was measured for eight of the 20 participants of this study. As shown in Figure 3, the average ORAC value at the end of the study was greatly increased (55%) compared to baseline (before any strawberry consumption).

Figure 3. Mean ORAC values at baseline and end of study in



eight participants.