ASSOCIATION OF NUTRIENT INTAKE, DIET AND HEALTH KNOWLEDGE, AND BIOLOGICAL PARAMETERS TO STRAWBERRY CONSUMPTION
Final Report
January 31, 2003

Executive Summary:

Using the Continuing Survey of Food Intake by Individuals, 1994-96, 1998 (CSFII), the Diet and Health Knowledge Survey (DHKS), and the National Health and Nutrition Examination Survey 1999-2000 (NHANES IV), all large government studies representative of the US population, we determined the association of strawberry consumption with nutrient intake, nutrition knowledge and biological parameters. We defined strawberry users as those individuals that consumed raw, cooked/canned, or frozen strawberries with and without added sweeteners.

In CSFII we identified almost 900 strawberry users (442 children and 448 adults). Strawberry users consumed more of numerous nutrients including dietary fiber, vitamin C, folate, calcium and potassium. Many, but not all, of the same nutrients were increased in both children and adults. Adult strawberry users, both men and women, exhibited significantly higher nutrition knowledge than non-users. To better understand the degree to which strawberries were responsible for the increased nutrient intake in strawberry users, we also examined the food sources of various nutrients mentioned above. Strawberry users obtained more of their vitamin C, folate, dietary fiber and potassium from fruit and fruit juices than non-users. It appeared that much of the increase in these nutrients were due to strawberry consumption. There was also an indication that strawberry users consumed less meat, poultry and fish than non-users.

In NHANES IV, we identified fewer strawberry users, about 200 individuals (73 children and 131 adults). Supporting the analyses of CSFII, again nutrient intake of strawberry users was significantly higher than non-users for many nutrients including dietary fiber, vitamin C, folate, calcium, and potassium. However, in children only vitamin C was significantly higher in strawberry users though many of the above mentioned nutrients were slightly higher in children (the smaller sample size of children may have an impact on being able to detect differences). Regarding biological parameters, adult strawberry users had higher serum and red blood cell folate levels and lower homocysteine (emerging risk factor for heart disease) levels. Adult strawberry users also had lower mean values for various iron status measures, including serum ferritin, hemoglobin, and hematocrit. However, all the iron status indicators were well within normal range. In children, strawberry users had lower body weight, lower body mass index, and a lower waist circumference. Young strawberry users also had lower iron status measures though again the mean values were within the normal range for children.

From these data it seems strawberry users are more knowledgeable of nutrition issues and act accordingly leading to better nutrient intake and in some cases better physiological status.

Introduction:

The Strawberry Commission of California was interested in learning more about the relationship of strawberry consumption to consumers' nutrition and health. To accomplish this objective we examined three government databases: 1) Continuing Survey of Food Intake by Individuals, 1994-96, 1998 (CSFII); 2) Diet and Health Knowledge Survey (DHKS); and 3) National Health and Nutrition Examination Survey 1999-2000 (NHANES IV). Further characteristics of each of these studies are found in Appendix A-D.

For each database, we defined strawberry consumers as those individuals that consumed raw, cooked/canned, or frozen strawberries with and without added sweeteners. We did not include strawberry juice or other forms of strawberries (in Danish, pie, cookies, etc,) in defining strawberry users. After identifying strawberry consumers we then calculated nutrient intake (including various measures of nutrient intake adequacy), diet and health knowledge, and biological parameters.

Methods:

CSFII is the latest, very large dietary survey conducted by the United States Department of Agriculture (USDA). The survey was a stratified random sample of the United States and contained 20,607 individuals though for various reasons we used a sample of 18,944 individuals aged 1 or more years. We eliminated children less than one year (n = 1486), children consuming breast milk (n = 65) and women that were pregnant and/or lactating (n = 112). For CSFII, we defined strawberry users as those consumers that consumed strawberries (raw, cooked/canned, or frozen strawberries with and without added sweeteners) on either of the two survey days. We then separated the survey population into four groups: 1) those with no strawberry consumption on either survey day; 2) those with strawberry consumption on at least one survey day; 3) those with strawberry consumption on only one survey day; and 4) those with strawberry consumption on both days. The main emphasis of this report is the comparison of strawberry users versus non-users on at least one survey day. However, we also provided a comparison of those consumers that consumed strawberries on neither, either or both days, though there were only a limited number of consumers that ate strawberries on both days. We separated our analyses by age and gender and thus provided separate charts for adults (defined as aged 20 years and more) and children (defined as aged 1 to 19 years) for both males and females.

DHKS was conducted on a sub-sample of CSFII 1994-96 subjects aged 20 years or more. A total of 5,597 individuals were given the DHKS survey questionnaire, however we used records from 5,649 individuals (we excluded those pregnant and/or lactating, n = 52). Again we defined strawberry users as mentioned above for CSFII and again the main comparison of interest was the comparison of strawberry users on at least one survey day versus non-users.

For CSFII and DHKS analyses, unweighted sample sizes were reported but proper sample weights (based on probability sampling) were applied for estimating means and percentages. Standard errors of the mean were calculated using the accepted linearization method of SUDAAN. Chi-square and t-test ($p < 0.05$, $p < 0.01$) were conducted comparing percentage and mean differences, respectively of strawberry consumers and non-consumers.

NHANES IV is the most recently released data from the Department of Health and Human Services (DHHS) regarding health and nutrition status in the US. NHANES IV is a national probability sample of the US conducted in 1999-2000 that contains a single 24-hr dietary recall and various measures of physiological status and indicators of health for 9,282 subjects. We defined strawberry users as those individuals that consumed raw, cooked/canned, or frozen strawberries with and without added sweeteners on the survey day. We eliminated 679 records as the dietary data from these subjects were not reliable or did not meet certain minimum criteria determined important by DHHS. We reported unweighted sample sizes but proper sample weights (based on probability sampling) were applied for estimating means. Standard errors of the mean were calculated using the Taylor method with SAS PROC SURVEYMEANS procedure. Analyses of variance (PROC SURVEYREG procedure in SAS) were conducted comparing differences of strawberry consumers and non-consumers and we used $p < 0.05$ to determine significant differences. For NHANES IV, we presented actual probabilities of differences between the user groups as this information may be useful to determine trends worth following as more data are released from DHHS (data on approximately 5,000 subjects are planned to be released each year).

Results

We have decided to focus this report on the significant findings from analyses of CSFII, DHKS and NHANES IV. However, in Appendices A-D we provided detailed analyses for each of the studies, including all variables examined whether significantly different or not. For CSFII and DHKS, since we had almost 900 strawberry users, we separated analyses by age (children: 1 to 19 years and adults: 20 years and older) and gender. For these data we also conducted various ways to examine nutrition intake (mean amount, mean percentage of recommended amount, percentage meeting/not meeting recommended intakes, and mean percentage of the new Estimated Average Requirements --EAR). For NHANES IV, since we only had 200 strawberry users, we only provided data separated by age (children: 19 years and less and adults: 20 years and older). Also, given limited numbers of strawberry users we decided to only present mean nutrient intake and mean values for biological parameters.

CSFII

There were 442 (181 males and 241 females) strawberry users (defined as consumption of strawberries on at least one survey day) aged 1 to 19 years and 448 (198 males and 250 females) strawberry users aged 20 years and more. There were 9,301 (4,789 males and

4,552 females) and 8,773 (4,553 males and 4,220 females) non-users aged 1 to 19 years and 20 years or more, respectively.

In children, strawberry users consumed more ($p<0.05$) dietary fiber, vitamin C, carotenes and less monounsaturated fat, cholesterol, and vitamin B12. The increase in vitamin C was observed in both boys and girls while the other changes in nutrient intake in children were due mainly to differences in intake of females (Table 1). In adults, strawberry users consumed more ($p<0.05$) carbohydrate, dietary fiber, vitamins A, E, C, B6, thiamin, riboflavin, folate, carotenes, potassium, magnesium, iron and copper. Adult strawberry users also consumed less saturated fat and more polyunsaturated fats. The differences in nutrient intake in strawberry users and non-users were fairly similar in men and women (Table 2) though there were numerous additional nutrients that were higher in female strawberry consumers as compared to non-users.

In Appendix A, we provided tables for children (all, boys separately, and girls separately) and adults (all, males separately, and females separately) comparing strawberry users to non-users regarding the percentage of recommended energy and nutrient intake, the percentage meeting recommendations for energy and nutrient intake, the percentage of individuals with inadequate intake and the mean nutrient intake as a percent of the Estimated Average Requirement (EAR). The following state some of the conclusions from these data:

> In children only 5% of strawberry users have inadequate vitamin C intake, while 20% of non-users have inadequate vitamin C intake. In adults, 15.8% of strawberry users have inadequate vitamin C intake, while over 47% of non-users have inadequate intake (Appendix A, table D1).
>
> In adults, a greater percentage of strawberry users meet requirements to limit total and saturated fat than non-users (Appendix A, table D4).
>
> In adults, a lower percentage of strawberry users have inadequate dietary fiber intake than non-users -- 52% for strawberry users and 74% for non-users (Appendix A, table D4).
>
> There is a lower percentage of adult female strawberry users that have inadequate intake of folate -- 71.5% for strawberry users and 84.8% for non-users (Appendix A, table D6).

The tables in Appendix A can be used to develop further statements comparing nutrient intake of strawberry users and non-users.

To better determine where the increased nutrients were coming from in strawberry users, we also examined the actual food sources of certain nutrients (calories, dietary fiber, vitamin C, folate and potassium) for strawberry users versus non-users. We found that:

Strawberry users obtained more calories from fruit and fruit juices (157 vs. 96 kcal or 8.4 vs. 4.9% of total kcal).

Strawberry users obtained fewer calories from meat, poultry and fish (255 vs. 321 kcal or 13.6 vs. 16.6% of total kcal).

Strawberry users obtained slightly fewer calories from other beverages, not including fruit juice (140 vs. 180 kcal or 7.5 vs. 9.3% of total kcals).

Strawberry users obtained more dietary fiber from fruit and fruit juices (3.3 vs. 1.5 g or 23.6 vs. 11.5% of total dietary fiber). This doubling of fiber from fruit explains most, if not all, of the increased dietary fiber consumption in strawberry users ("melons and berries" sub-section provided 1.6 vs. 0 g).

Strawberry users obtained more vitamin C from fruit and fruit juices (82 vs. 40 mg or 65 vs. 41% of total vitamin C). A very significant proportion of the difference in vitamin C consumption comes from the "melons and berries" group within fruit and fruit juice category (32 vs. 2 mg). Strawberry users get less vitamin C from other beverages (13 vs. 20 mg or 10 vs. 21% of total vitamin C).

Strawberry users obtained more folate from fruit and fruit juices (43 vs. 23 μg or 17.2 vs. 9.3% of total folate). A significant proportion of the difference in folate consumption comes from the "melons and berries" group within fruit and fruit juice category (10 vs. 1 μg).

Strawberry users obtained more potassium from fruit and fruit juices (535 vs. 300 mg or 22 vs. 13% of total potassium). Again the "melons and berries" sub-section provided considerably to this difference (131 vs. 18 mg). There are also slight decreases in potassium from grains (398 vs. 417 mg), vegetables (383 vs. 430 mg) and meat, poultry and fish (331 vs. 396 mg) in strawberry users.

For more information on these analyses and results see Appendix B.

DHKS

There were 266 strawberry users and 5,331 non-users that completed the DHKS survey questionnaires. Adult strawberry users appeared to have significantly higher knowledge regarding nutrition issues than non-users. For example, a greater percentage ($p<0.05$) of strawberry users responded correctly to at least eight of eleven nutrition knowledge questions -- 45.8% versus 28.8% for users and non-users, respectively. Additionally, significantly more strawberry users correctly answered five of six questions regarding which food had more fat (the percentage of strawberry users and non-users correctly answering the question regarding pork spare ribs vs. pork loin was similar). Strawberry users were also more likely to respond “three or more” when asked the number of servings of fruit recommended each day. In general the higher nutrition knowledge in

strawberry users was present in both men and women though women, in general, had greater nutrition knowledge than men (Table 3).

For information on these analyses and results see Appendix C.

NHANES IV

There were 73 strawberry users (defined as consumption of raw, cooked/canned, or frozen strawberries with and without added sweeteners) aged 1 to 19 years and 131 strawberry users aged 20 years and more. There were 2,700 and 3,936 non-users aged 1 to 19 years and 20 years or more, respectively.

In adults (aged 20 years and higher), strawberry users consumed more ($p< 0.05$) carbohydrates, dietary fiber, vitamin C, thiamin, riboflavin, folate, calcium, potassium and magnesium than non-users (Table 4). Adult strawberry users consumed over 100% more vitamin C, almost 30% more dietary fiber and almost 25% more folate than non-users. Regarding mineral intake, strawberry users consumed over 15% more calcium and potassium. Adult strawberry users also had increased consumption of vitamin A, vitamin B6, iron and copper that approached significance ($p < 0.10$). Nutrient intakes by gender were not calculated as the number of subjects was too small to base firm conclusions.

In children (aged 19 years and younger), strawberry users consumed more ($p<0.05$) vitamin C than non-users. Intakes of other nutrients were not different among strawberry users and non-users. Since we have less than 100 children that consumed strawberries in NHANES IV, caution must be used when making broad conclusions with these data.

One of the main advantages of using NHANES IV is that certain physiological data are also available. Adult strawberry users had higher ($p<0.05$) serum folate, red blood cell folate and lower homocysteine (emerging risk factor for heart disease) than non-users. It is biologically meaningful that higher folate levels (serum and red blood cell) are associated with lower homocysteine levels as folate, along with vitamin B_6 and B_{12}, is known to lower homocysteine levels). There were no differences ($p > 0.05$) in strawberry users and non-users in body weight, body fat measures, or total cholesterol measures however, serum triglycerides were lower in strawberry users than non-users (122 vs. 141 mg/dL). Strawberry users also had significantly lower ($p < 0.05$) ferritin, hemoglobin, red blood cell count, and hematocrit, calcium and phosphorus (Table 5). Interestingly, while these differences were statistically significant all of the mean values remained well within the normal range[1].

In children, strawberry users had lower ($p<0.05$) ferritin, red blood cell count, hemoglobin, and hematocrit. Again, the mean values for strawberry users for these variables were typically within normal ranges for children. Strawberry users also had

[1] Normal ranges in adults for 1) red blood cells are 4.6-6.2 SI for males and 4.2-5.4 SI for females; 2) hematocrit is 40-50% in males and 37-47% in females; 3) hemoglobin is 14-18 g/dL for males and 12-16 g/dL for females; 4) ferritin is 18-270 ng/ml in males and 18-160 ng/m in females; 5) serum calcium is 9-10.5mg/dL in adults; and 6) serum phosphorus is 2.5-4.5 mg/dL in adults.

lower C-reactive protein, body mass index, body weight, and waist circumference (Table 6). This suggests that children that consumed strawberries are more likely to be closer to their ideal weight. Care should be taken in interpreting these data with children, as the numbers of strawberry users were less than 100, the typical cell size minimum used for detailed analyses.

For more information on these analyses and results see Appendix D.

Discussion:

There was considerable consistency of results from CSFII and NHANES IV regarding beneficial nutrient consumption of strawberry users. Increased consumption of several nutrients was observed in both children and adult strawberry users as compared to non-users. While analyses like those contained in this report can never assign cause and effect, given the nutrient content of strawberries it seems quite plausible that the increases in folate, dietary fiber, vitamin C, potassium and carotenes are due, at least in part to the consumption of strawberries. From the analysis of other foods consumed in CSFII, it appears strawberry users tend to consume less meat and consume more fruits and fruit juices than non-users. This suggests that a greater proportion of strawberry users were vegetarian or at least ate more meals that have limited amounts of meat products. The decreased meat consumption might explain the slightly lower iron status in adult and children strawberry users. However, again we must mention that mean values for the iron status variables were within normal ranges.

The linkage of nutrient intake to physiological measures appears quite strong for folate related parameters. Folate intake was higher in adult strawberry users in both CSFII and NHANES IV. Serum and red blood cell folate levels were higher in strawberry users while homocysteine was lower. This supports the well-known effects of folate on reducing homocysteine levels.

It certainly appears that consumption of strawberries is associated with a dietary pattern that more closely resembles that being recommended by most nutrition professionals. Strawberry users appear to have greater nutrition knowledge than non-users and it is interesting to speculate that consumption of strawberries is part of the application of their increased knowledge. These data also support that a serving of strawberries can provide important improvements in the diet of many Americans.

Table 1. Differences in daily nutrient intake in children aged 1-19 years in CSFII by strawberry consumption[1,2,3]

	All		Boys		Girls	
Dietary Variables	User (n=442)	Non-user (n=9,301)	User (n=181)	Non-user (n=4,789)	User (n=241)	Non-user (n=4,552)
Monounsaturated Fat, g	**24.4**[4] **(1.1)**	**27.2 (0.3)**	29.2 (2.6)	30.5 (0.4)	**21.3 (1.1)**	**23.7 (0.3)**
Cholesterol, mg	**200 (11)**	**226 (4)**	249 (25)	226 (4)	**170 (9)**	**196 (4)**
Dietary Fiber, g	**14.0 (0.6)**	**12.7 (0.2)**	15.3 (1.0)	14.0 (0.2)	**13.2 (0.7)**	**11.4 (0.2)**
Vitamin C, mg	**127.0 (6.8)**	**97.7 (2.2)**	**131.4 (10.3)**	**104.5 (2.6)**	**124.4 (8.1)**	**90.3 (2.4)**
Vitamin B_{12}, μg	**3.81 (0.18)**	**4.26 (0.08)**	4.46 (0.40)	4.74 (0.09)	3.40 (0.18)	3.74 (0.11)
Carotenes, mg	**435 (54)**	**314 (9)**	471 (84)	336 (13)	**413 (55)**	**290 (12)**

[1]CSFII, 1994-96, 98

[2]Bolded numbers within a nutrient/group are significantly different ($p < 0.05$)

[3]Protein intake (g/kg body weight) was also higher in male strawberry users (2.56 vs. 2.30)

[4]Mean and standard error estimated by linearization via SUDAAN

Table 2. Differences in daily nutrient intake in adults aged 20 years or more in CSFII by strawberry consumption[1,2,3]

	All		Men		Women	
Dietary Variables	User (n=448)	Non-user (n=8,773)	User (n=198)	Non-user (n=4,553)	User (n=250)	Non-user (n=4,220)
Saturated Fat, g	**23.3**[4] **(0.7)**	**25.0 (0.4)**	**27.9 (1.3)**	**30.9 (0.8)**	20.2 (0.7)	19.3 (0.2)
Polyunsaturated Fat, g	**16.1 (0.5)**	**15.1 (0.2)**	19.5 (1.1)	18.0 (0.2)	**13.7 (0.5)**	**12.3 (0.2)**
Carbohydrates, g	**263 (7)**	**247 (3)**	**312 (9)**	**291 (4)**	**229 (8)**	**204 (2)**
Dietary Fiber, g	**19.3 (0.56)**	**15.5 (0.2)**	**22.3 (0.8)**	**17.9 (0.2)**	**17.3 (0.5)**	**13.2 (0.2)**
Vitamin A, RE	**1165 (50)**	**987 (18)**	**1341 (74)**	**1080 (21)**	**1043 (56)**	**898 (22)**
Vitamin E, TE	**9.7 (0.5)**	**8.1 (0.1)**	**11.4 (0.6)**	**9.6 (0.2)**	**8.6 (0.6)**	**6.8 (0.1)**
Vitamin C, mg	**151.4 (6.1)**	**92.4 (1.8)**	**172.2 (8.5)**	**101.8 (2.6)**	**137.0 (6.5)**	**83.4 (1.8)**
Thiamin, mg	**1.73 (0.05)**	**1.57 (0.02)**	**2.03 (0.07)**	**1.87 (0.03)**	**1.53 (0.06)**	**1.28 (0.01)**
Riboflavin, mg	**2.01 (0.05)**	**1.84 (0.02)**	**2.32 (0.06)**	**2.18 (0.04)**	**1.79 (0.07)**	**1.51 (0.02)**
Vitamin B_6, mg	**2.01 (0.06)**	**1.77 (0.02)**	**2.35 (0.07)**	**2.11 (0.03)**	**1.76 (0.07)**	**1.45 (0.01)**
Folate, μg	**306 (11)**	**251 (3)**	**347 (12)**	**291 (4)**	**277 (15)**	**213 (3)**
Potassium, mg	**3020 (52)**	**2670 (26)**	**3511 (86)**	**3115 (40)**	**2680 (66)**	**2241 (18)**
Magnesium, mg	**298 (7)**	**270 (3)**	**349 (11)**	**317 (4)**	**264 (7)**	**225 (2)**
Iron, mg	**16.5 (0.6)**	**15.2 (0.2)**	**19.7 (0.6)**	**18.1 (0.3)**	**14.3 (0.7)**	**12.3 (0.1)**
Copper, mg	**1.33 (0.03)**	**1.22 (0.01)**	**1.58 (0.05)**	**1.43 (002)**	**1.15 (0.03)**	**1.01 (0.01)**
Carotenes, mg	**680 (44)**	**508 (11)**	**798 (64)**	**528 (12)**	**598 (43)**	**489 (14)**

[1]CSFII, 1994-96, 98

[2]Bolded numbers within a nutrient/group are significantly different ($p < 0.05$)

[3] In female strawberry users, calories (1732 vs. 1586 kcal), intake of protein (66.9 vs. 61.5 g and 1.02 vs. 0.94 g/kg body weight), niacin (20.4 vs. 18.2 mg), calcium (718 vs. 615 mg), phosphorus (1124 vs. 982 mg), zinc (9.7 vs. 8.8 mg), selenium (90.7 vs. 83.8 μg) and sodium (2901 vs. 2676 mg) were also higher as compared to non-users. In male strawberry users, cholesterol intake was lower (295 vs. 329 mg) than in non-users.

[4]Mean and standard error estimated by linearization via SUDAAN

Table 3. Differences in nutrition knowledge in adults age 20 years or more by strawberry consumption[1,2]

	All		Men		Women	
Questions	User (n=266)	Non-user (n=5,331)	User (n=110)	Non-user (n=2,736)	User (n=156)	Non-user (n=2,595)
Servings of fruit: 3 or more	**66.6**[3] **(3.9)**	**55.0 (1.3)**	57.6 (6.5)	47.9 (1.5)	72.2 (4.9)	61.7 (1.7)
Knowledge Score: 8 or more correct	**45.9 (4.1)**	**28.8 (1.1)**	**42.9 (6.9)**	**26.6 (1.3)**	**47.7 (6.0)**	**30.9 (1.5)**
Which has more fat?						
Regular hamburger or Ground round	**86.8 (2.8)**	**78.9 (1.1)**	85.2 (4.9)	75.7 (1.7)	87.7 (3.2)	82.1 (1.2)
Pork Spareribs or Pork loin chops	69.8 (3.8)	65.7 (0.9)	**73.2 (4.6)**	**62.0 (1.3)**	67.7 (5.4)	69.3 (1.2)
Hot dogs or Ham	**70.0 (4.5)**	**61.2 (1.3)**	**76.1 (6.3)**	**61.3 (2.1)**	66.1 (5.3)	61.0 (1.4)
Peanuts or Popcorn	**93.7 (1.9)**	**85.9 (0.9)**	**94.0 (2.6)**	**82.3 (1.4)**	93.5 (2.3)	89.4 (0.8)
Sour cream or Yogurt	**93.8 (1.4)**	**84.0 (1.5)**	**94.7 (2.3)**	**81.6 (1.7)**	**93.2 (2.0)**	**86.4 (1.6)**
Porterhouse steak or Round steak	**60.3 (3.7)**	**48.3 (1.2)**	**66.0 (6.0)**	**47.0 (1.6)**	**56.6 (4.9)**	**49.5 (1.5)**

[1]DHKS

[2]Bolded numbers within a question/group are significantly different ($p < 0.05$)

[3]Mean and standard error estimated by linearization via SUDAAN

Table 4. Nutrient intake in adults aged 20 years or more in NHANES IV by strawberry consumption[1,2]

	All	
Dietary Variables	User (n=131)	Non-user (n=3936)
Carbohydrates, g	**306**[3] **(15)**	**275 (3)**
Dietary Fiber, g	**20.1 (1.3)**	**15.5 (0.2)**
Vitamin A, IU	7996 (795)	6542 (223)
Vitamin C, mg	**189.5 (18.1)**	**94.0 (1.9)**
Thiamin, mg	**1.88 (0.1)**	**1.64 (0.02)**
Riboflavin, mg	**2.23 (0.05)**	**1.96 (0.02)**
Vitamin B_6, mg	2.07 (0.06)	1.86 (0.03)
Folate, μg	**460 (26)**	**371 (5)**
Potassium, mg	**3229 (140)**	**2769 (29)**
Calcium, mg	**994 (53)**	**849 (14)**
Magnesium, mg	**330 (16)**	**289 (4)**
Iron, mg	17.3 (1.0)	15.4 (0.2)
Copper, mg	1.46 (0.08)	1.31 (0.02)
Carotenes, mg	608 (76)	494 (21)

[1]NHANES IV, 1999-2000

[2]Bolded numbers within a nutrient are significantly different ($p < 0.05$)

[3]Mean and standard error estimated by Taylor linearization via SAS

Table 5. Select physiological parameters in adults aged 20 years or more in NHANES IV by strawberry consumption[1,2]

	All	
Physiological Parameters	User (n=131)[3]	Non-user (n=3936)
Serum Folate, ng/ml	**19.5**[4] **(1.3)**	**15.7 (0.2)**
Red Blood Cell Folate, ng/ml RBC	**362 (15.8)**	**310 (3)**
Homocysteine, µmol/L	**7.1 (0.2)**	**8.0 (0.1)**
Triglycerides, mg/dL	**121.9 (8.9)**	**141.2 (2.3)**
Serum Calcium, mg/dL	**9.30 (0.04)**	**9.43 (0.01)**
Serum Phosphorus, mg/dL	**3.31 (0.1)**	**3.44 (0.01)**
Ferritin, ng/ml	**84.4 (8.0)**	**129.1 (2.9)**
Hemoglobin, g/dL	**14.00 (0.14)**	**14.44 (0.03)**
Red Blood Cell Count, SI	**4.6 (0.05)**	**4.7 (0.01)**
Hematocrit, %	**41.8 (0.4)**	**42.7 (0.1)**
Systolic Blood Pressure, mm Hg	119.8 (1.9)	122.8 (0.4)
Diastolic Blood Pressure, mm Hg	70.9 (1.2)	73.0 (0.2)

[1]NHANES IV, 1999-2000

[2]Bolded numbers are significantly different ($p < 0.05$)

[3]Actual number of observations varies from 122 to 131 for strawberry users and from 3693 to 3772 for non-users

[4]Mean and standard error estimated by Taylor linearization via SAS

Normal ranges in adults for 1) red blood cells are 4.6-6.2 SI for males and 4.2-5.4 SI for females; 2) hematocrit is 40-50% in males and 37-47% in females; 3) hemoglobin is 14-18 g/dL for males and 12-16 g/dL for females; 4) ferritin is 18-270 ng/ml in males and 18-160 in females; 5) serum calcium is 9-10.5mg/dL in adults; and 6) serum phosphorus is 2.5-4.5 mg/dL in adults.

Table 6. Select physiological parameters in children aged 19 years or less in NHANES IV by strawberry consumption[1,2]

	All	
Physiological Parameters	User (n=73)[3]	Non-user (n=2,700)
Ferritin, ng/ml	**28.9 (1.8)**	**44.0 (1.2)**
Hemoglobin, g/dL	**13.5 (0.14)**	**13.96 (0.04)**
Red Blood Cell Count, SI	**4.5 (0.06)**	**4.7 (0.01)**
Hematocrit, %	**39.8 (0.5)**	**41.2 (0.1)**
C-Reactive Protein, mg/dL	**41.8 (0.4)**	**42.7 (0.1)**
Body Mass Index, kg/m^2	**20.3 (0.6)**	**21.9 (0.1)**
Body Weight, kg	**48.5 (2.6)**	**56.2 (0.6)**
Waist Circumference, cm	**70.6 (1.6)**	**76.1 (0.4)**
Homocysteine, µmol/L	4.9 (0.3)	5.3 (0.1)
Systolic Blood Pressure, mm Hg	104.3 (1.5)	107.1 (0.3)

[1]NHANES IV, 1999-2000

[2]Bolded numbers are significantly different ($p < 0.05$)

[3]Actual number of observations varies from 55 to 73 for strawberry users and from 2,484 to 2,700 for non-users

[4]Mean and standard error estimated by Taylor linearization via SAS

Normal ranges in children for 1) red blood cells are 4.6-4.8 SI; 2) hematocrit is 31-41%; and 3) ferritin is 7-140 ng/ml.