Changes in the Nutritional Quality of Products Offered for Sale

This section presents measures of nutritional quality change based on the Padberg index and nutrient-by-nutrient analysis for products offered for sale by manufacturers in the five selected food product categories in the years studied. In addition, it presents an investigation of the nutritional quality of entering and exiting brands of food products.

Measure 1: Mean Index Values of Nutritional Quality and Changes in Index Values

Measure 1 involves calculating Padberg index values for each product and then computing mean index values for each food product category and year considered. Then nutritional quality change is measured as the difference in the mean value of the index for each pair of years. Positive and statistically significant changes in the values of the computed quality indexes would imply improvement in the nutritional quality of the food categories examined. On the other hand, negative and statistically significant changes in indexes would suggest a decline in quality.

The calculated mean index values and changes in them are presented in table 6 for food product offerings in the five selected food categories. The years covered vary by product category, depending on the availability of nutrition information. For entrees, salted snacks, and cookies, the indexes for 1994, 1995, and 1997 and their changes were calculated. For soup, the indexes for 1995 and 1997 and their differences were obtained. For these four categories, the analysis covers only the post-NLEA period because information on the nutritional composition of these foods was very incomplete for earlier years. For the processed meats and bacon category, it was possible to compute quality indexes and their changes for each of the years 1992-95 and 1997, which includes both pre- and post-NLEA periods.

Analysis of the point changes in the index values reveals that most of these changes were small during the time period studied and none were statistically significant (see details on next page). For the Padberg index, positive point changes indicate improvements in nutritional quality whereas negative values show a

Table 6—Products offered for sale: Nutrition index values and changes by year and category, selected years, 1992-97

						Changes					
	Mean					Between years				Over longest time periods possible	
Food category	1992	1993	1994	1995	1997	1992-93	1993-94	1994-95	1995-97	1994-97	1992-97
			Index					*Points*			
Entrees	—	—	37.3	36.3	34.7	—	—	-1.00	-1.60	-2.60	—
Frozen entrees/dinners[1]	—	—	36.0	32.2	32.0	—	—	-3.80	-.30	-4.00	—
Frozen entrees[2]	—	—	40.7	39.0	38.0	—	—	-1.70	-1.00	-2.70	—
Shelf-stable entrees	—	—	40.6	43.1	41.7	—	—	2.50	-1.50	1.10	—
Frozen pizza	—	—	31.0	32.6	29.1	—	—	1.50	-3.50	-1.90	—
Soup	—	—	—	47.1	47.9	—	—	—	.80	—	—
Salted snacks	—	—	55.6	56.3	57.7	—	—	.70	1.40	2.10	—
Crackers	—	—	55.8	57.7	58.8	—	—	1.90	1.10	3.00	—
Potato chips	—	—	52.9	50.7	49.5	—	—	-2.20	-1.20	-3.40	—
Corn chips	—	—	57.7	58.2	58.0	—	—	.50	-.20	.30	—
Other salted snacks	—	—	54.8	56.5	56.4	—	—	1.70	-.10	1.60	—
Cookies	—	—	61.8	62.1	61.7	—	—	.30	-.40	-.10	—
Processed meats and bacon	38.8	41.4	41.5	39.8	42.7	2.60	0.10	-1.70	2.90	—	3.90

— = Not available.
[1]Single-serving products.
[2]Multiple-serving products.

quality decline. On average, the indexes for entrees fell consistently over the years studied and rose consistently for soup and salted snacks. The indexes for cookies and processed meats and bacon rose and fell from year to year. In the processed meats and bacon category, nutritional quality improved the most in 1992-93 (a pre-regulation period) and in 1995-97 (a post-regulation period), with the magnitude of the changes being almost the same in both of these periods (2.6 versus 2.9 points). This finding suggests that, at least in this product category, there was no difference in the pace and direction of the nutritional quality change immediately before and after the introduction of the NLEA.

The final three columns of table 6 show index point changes over the longest time periods possible, given the availability of nutrition data. For entrees and cookies, the mean nutritional quality index decreased in the period 1994-97, by 2.6 and 0.1 index points, respectively. For soup in 1995-97, salted snacks in 1994-97, and processed meats and bacon in 1992-97, the changes were positive, equaling 0.8, 2.1, and 3.9 points, respectively.

The nonpooled t-test for two population means was used to test the statistical significance of changes in the mean index values between the examined years. The nonpooled t-procedure requires independent samples and normally distributed populations with standard deviations not necessarily being equal. The assumption of independent samples is essential; the samples must be independent or the procedure does not apply. The nonpooled t-test is robust to moderate deviations from the normality assumption. This test can be applied to large samples from non-normal populations and works reasonably well even for small samples from non-normal populations. The procedure is valid in this case because we are dealing with independent and large samples.

Because the direction of change in nutrition indexes would not be limited to either a positive or a negative change, a two-tailed test is performed for all the comparisons. The nonpooled t-test allows us to reject or fail to reject the null hypothesis that the two population means are the same. For example, rejection of the hypothesis for the observed positive changes in the mean index values for salted snacks would suggest that the positive change in the nutritional quality of salted snacks offered for sale has been statistically significant. Failure to reject the null hypothesis would indicate that, given the information available in the sample, a change in the population index means cannot be inferred.

As noted earlier, the calculated t-test statistics for the nonpooled test have to be based on a large number of observations for each product category. Therefore, for entrees and salted snacks, the tests of significance were performed for the whole category instead of for each subcategory separately. None of the subcategories had enough observations to reliably use the tests of statistical significance. At 95 percent and 90 percent significance levels, the test statistics failed to reject the null hypothesis of equal means of the computed index values for all of the categories and years in question. None of the observed changes in the nutritional quality of food products offered for sale in the categories examined here was statistically significant.

A possible weakness of this analysis is that it relies primarily on means as estimates, so the only condition we are able to account for is the number of observations. It also relies on the t-test to detect significant changes in these means. In addition, Padberg's index does not capture the value of particular food products in a total diet and is not useful for cross-category comparisons. For example, the values of the calculated indexes suggest that the least nutritious foods among those examined here were frozen pizza and frozen entrees. The index values were the lowest for these food product categories and ranged from 29.1 for frozen pizza in 1997 to 40.7 for frozen entrees in 1994. The most nutritious foods were cookies and salted snacks, for which the index values ranged from 49.5 for potato chips in 1997 to 61.8 for cookies in 1994.

In summary, based on the computed quality indexes and their changes, we conclude that the nutritional quality of food products offered for sale by manufacturers did not change significantly in any of the food categories in the years studied during the mid-1990's. For the one food category, processed meats and bacon, for which pre- and post-NLEA implementation data are available, no change in the direction or rate of change in nutritional quality is evident between the two periods. For the other four food categories, the period of analysis in this study may cover too short a time period (1994-97 or 1995-97) to detect significant changes in the nutritional quality of food product offerings. In addition, significant differences in the timing and rate of product change are likely across product categories. The nutritional quality in some cat-

egories may have changed before the period studied (for example, in the late 1980's), while the quality in others may change in the future. Thus, these results should be interpreted as a snapshot of nutritional quality change in the categories and years studied.

Measure 2: Changes in Individual Nutrients

The computed Padberg quality indexes showed little change in nutritional quality for the food product categories considered here. Given that the Padberg index is one of a large family of possible overall quality indexes that could yield somewhat different results, a second method of investigation was also applied to further explore change in the nutritional quality of food products offered for sale. This approach focused on changes in the amounts of individual nutrients listed on the nutrition panels of products. Once again, the nonpooled two-tail t-test was used to detect significant changes in the levels of nutrients. If the changes in the overall nutrition indexes were insignificant but some of the changes in nutrients were significant, it could provide evidence of changes in food product offerings.

Tables 7 through 11 report mean nutrient values per serving and their percentage changes for the five food product categories and the years considered. In terms of percentage change, the mean values for individual nutrient levels in soup, salted snacks, and processed meats and bacon did move in a desirable direction. The levels of undesirable nutrients, such as fat, saturated fat, or cholesterol, decreased, and the levels of desirable nutrients, such as vitamins, calcium, and iron, increased. Specifically, in soup, the level of fat,

Table 7—Entrees offered for sale: Mean nutrient values per serving, 1994-97

	Mean			Change		
Nutrient	1994	1995	1997	1994-95	1995-97	1994-97
	----------Nutrient per serving----------			*----------Percent----------*		
Calories	311.9	309.6	323.9	-0.7	4.6	3.9
Fat (g)	13.1	13.2	14.7	1.0	11.1	12.2
Saturated fat (g)	4.8	4.8	5.3	1.0	9.6	10.6
Cholesterol (mg)	37.6	36.7	36.9	-2.4	.5	-1.9
Sodium (mg)	777.3	782.2	803.6	.6	2.7	3.4
Carbohydrates (%DV)	11.1	10.9	11.2	-1.7	3.0	1.3
Fiber (%DV)	12.1	10.9	12.6	-9.4	15.1	4.3
Protein (g)	15.1	14.3	15.1	-4.8	5.4	.3
Vitamin A (%DV)	12.0	10.4	13.1	-13.0	25.6	9.3
Vitamin C (%DV)	6.3	4.9	6.4	-21.3	29.7	2.1
Calcium (%DV)	12.8	12.0	11.7	-6.1	-2.8	-8.8
Iron (%DV)	9.7	9.9	8.3	2.4	-16.8	-14.8

g = Grams, mg = Milligrams, %DV = Percent of daily value.

Table 8—Soup offered for sale: Mean nutrient values per serving, 1995-97

	Mean		Change,
Nutrient	1995	1997	1995-97
	--------Nutrient per serving--------		*Percent*
Calories (g)	133.0	126.0	-5.3
Fat (g)	4.4	3.9	-11.4
Saturated fat (g)	1.6	1.4	-12.5
Cholesterol (mg)	13.5	12.1	-10.4
Sodium (mg)	526.6	510.8	-3.0
Carbohydrates (%DV)	46.5	43.9	-5.6
Fiber (%DV)	6.3	5.8	-7.9
Protein (g)	5.2	4.9	-5.8
Vitamin A (%DV)	18.6	14.8	-20.4*
Vitamin C (%DV)	16.9	14.4	-14.8
Calcium (%DV)	2.9	2.7	-6.9
Iron (%DV)	6.1	6.1	0

g = Grams, mg = Milligrams, %DV = Percent of daily value.
*Significant at the 90-percent level.

Table 9—Salted snacks offered for sale: Mean nutrient values per serving, 1994-97

Nutrient	Mean			Change		
	1994	1995	1997	1994-95	1995-97	1994-97
	Nutrient per serving			*Percent*		
Calories (g)	129.3	123.1	122.5	-4.8	-0.5	-5.3
Fat (g)	6.5	5.2	5.1	-20.0	-2.0	-21.5*
Saturated fat (g)	1.2	.9	.8	-25.0**	-11.1	-33.3**
Cholesterol (mg)	.5	.4	.4	-20.0	0	-20.0
Sodium (mg)	210.0	198.0	201.4	-5.7	1.7	-4.1
Carbohydrates (%DV)	27.7	25.8	24.8	-6.9	-3.9	-10.5
Fiber (%DV)	1.8	1.8	1.7	0	-5.6	-5.6
Protein (g)	2.3	2.1	2.2	-8.7	4.8	-4.4
Vitamin A (%DV)	.2	.3	.3	50.0**	0	50.0**
Vitamin C (%DV)	5.8	5.6	5.2	-3.5	-7.1	-10.3
Calcium (%DV)	2.1	2.0	2.3	-4.8	15.0	9.5
Iron (%DV)	3.9	4.1	4.5	5.1	9.8	15.4

g = Grams, mg = Milligrams, %DV = Percent of daily value.
*Significant at the 90-percent level.
**Significant at the 95-percent level.

Table 10—Cookies offered for sale: Mean nutrient values per serving, 1994-97

Nutrient	Mean			Change		
	1994	1995	1997	1994-95	1995-97	1994-97
	Nutrient per serving			*Percent*		
Calories (g)	117.2	116.2	117.2	-0.9	0.9	0
Fat (g)	4.1	3.9	4.1	-5.1	4.6	-.7
Saturated fat (g)	1.4	1.3	1.5	-5.0	11.3	5.7
Cholesterol (mg)	2.5	2.9	2.2	16.4	-24.1*	-11.6
Sodium (mg)	98.3	96.8	90.2	-1.5	-6.8	-8.3
Carbohydrates (%DV)	6.4	6.5	6.3	.5	-3.4	-3.0
Fiber (%DV)	3.5	3.4	2.9	-2.8	-16.9	-19.3*
Protein (g)	2.1	1.6	1.4	-24.9*	-13.8	-35.2*
Vitamin A (%DV)	.7	.6	.6	-11.1	-6.3	-16.7
Vitamin C (%DV)	.1	0	.1	0	0	0
Calcium (%DV)	.3	.5	.4	42.4*	-19.1*	15.2
Iron (%DV)	3.4	3.7	3.5	6.4	-3.6	2.6

g = Grams, mg = Milligrams, %DV = Percent of daily value.
*Significant at the 90-percent level.

Table 11—Processed meats and bacon offered for sale: Mean nutrient values per serving, 1992-97

Nutrient	Mean					Change				
	1992	1993	1994	1995	1997	1992-93	1993-94	1994-95	1995-97	1992-97
	Nutrient per serving					*Percent*				
Calories (g)	98.4	91.9	103.3	107.5	95.9	-6.60	12.40	4.10	-10.80	-2.50
Fat (g)	8.1	7.6	8.1	8.7	7.4	-6.20	6.60	7.40	-14.90	-8.60
Saturated fat (g)	3.6	3.3	3.2	3.5	2.9	-8.30	-3.00	9.40	-17.10*	-19.40*
Cholesterol (mg)	23.1	22.0	25.3	26.2	24.1	-4.80	15.00	3.60	-8.00	4.30
Sodium (mg)	376.0	360.0	422.4	441.1	430.8	-4.26	17.30*	4.40	-2.30	14.60
Carbohydrates (%DV)	6.5	.9	1.4	1.0	1.5	-86.20**	55.60**	-28.60**	50.00**	-76.90**
Fiber (%DV)	0	0	.1	0	0	0	0	0	0	0
Protein (g)	5.2	4.9	6.0	6.3	6.0	-5.80	22.50*	5.00	-4.80	15.40*
Vitamin A (%DV)	.6	.6	1.1	.6	.1	0	83.30**	-45.50**	-83.30**	-83.30**
Vitamin C (%DV)	2.1	2.0	2.3	2.5	2.3	-4.80	15.00	8.70	-8.00	9.50
Calcium (%DV)	.4	1.2	1.2	1.0	.7	20.00*	0	-16.70*	-30.00**	75.00**
Iron (%DV)	.6	2.3	2.3	2.7	2.2	28.30**	0	17.40*	-18.50*	26.70**

g = Grams, mg = Milligrams, %DV = Percent of daily value.
*Significant at the 90-percent level.
**Significant at the 95-percent level.

saturated fat, and cholesterol decreased by 11 percent, 12 percent, and 10 percent, respectively, between 1995 and 1997. In salted snacks, the levels of these three undesirable nutrients were lower by 21 percent, 33 percent, and 20 percent, respectively, in 1994-97. In the processed meats and bacon category, fat and saturated fat declined by 9 percent and 19 percent, respectively, in 1992-97. But another undesirable nutrient, sodium, increased by 15 percent. Also, calcium and iron (desirable nutrients) increased by 75 percent and 27 percent, respectively, for this food category in the examined period. Carbohydrates declined by 77 percent. The major changes in entrees from 1994 to 1997 were a 12-percent increase in fat and an 11-percent increase in cholesterol. In cookies, the mean value of cholesterol decreased by almost 12 percent in 1994-97 and sodium decreased by 8 percent. However, at the same time, the average fiber content fell by 19 percent.

Most of the changes were found to be statistically insignificant using the nonpooled t-test at the 95-percent level. The only significant changes at the 95-percent level were in saturated fat and vitamin A in salted snacks and in carbohydrates, vitamin A, calcium, and iron in processed meats and bacon. At the 90-percent level, the number of statistically significant changes in nutrients increased. These additional significant changes are in the following nutrient contents: vitamin A in soup, fat in salted snacks, fiber and protein in cookies, and saturated fat and protein in processed meats and bacon. In general, if nutrient contents changed significantly, increases in desirable nutrients were offset by increases in undesirable nutrients or decreases in undesirable nutrients accompanied decreases in desirable nutrients.

Overall, the nutrient changes and the index value changes suggest that the average nutritional quality of foods offered for sale did not improve significantly in the examined period, except for the salted snacks and processed meats and bacon categories, where the levels of fat, saturated fat, and carbohydrates declined and the levels of protein, vitamin A, calcium, and iron increased significantly.

Nutritional Quality of Entering and Exiting Brands

To provide another perspective on developments in nutritional quality, we examined the mean Padberg index values of entering and exiting food product brands. Table 12 reports the mean index values for all the brands that entered and exited the five food product categories between 1994 and 1995 and between 1995 and 1997. These periods were chosen because they reflect similar trends in the earlier time periods and have the largest number of observations. Data availability

Table 12—Nutrition index values for entering and exiting brands offered for sale, 1995 and 1997

Product	1995[1]		1997[2]	
	Mean	Observations	Mean	Observations
	Index	*Number*	*Index*	*Number*
Entrees	36.30	74	34.70	76
Entering products	43.00	18	46.99	12
Exiting products	40.00	4	48.00	10
Soup	47.10	55	47.90	69
Entering products	50.80	10	49.70	12
Exiting products	47.70	6	48.00	8
Salted snacks	56.30	91	57.70	104
Entering products	58.50	21	59.20	18
Exiting products	56.90	12	58.40	10
Cookies	62.10	50	61.70	57
Entering products	63.90	10	64.33	10
Exiting products	62.89	8	69.55	3
Processed meats and bacon	39.80	53	42.70	52
Entering products	40.70	11	43.50	10
Exiting products	40.10	9	43.10	7

[1]Product entry and exit measured from 1994 to 1995.
[2]Product entry and exit measured from 1995 to 1997.

improved in 1995 and 1997 because almost all products were labeled and information on their nutritional composition was fully available. However, the sample sizes of entering and exiting products are too small to test for statistical significance.

For the soup, salted snacks, and processed meats and bacon categories, the nutritional quality index of the products that entered the supermarket was higher than for those that exited in 1995 and in 1997. This would imply an improvement in the average quality. On the other hand, for entrees and cookies, the entering brands were more nutritious than the exiting brands in 1995, while the reverse was true in 1997. This in turn would imply a decrease in average quality in 1997. The above findings are consistent with the pattern of change in overall index means for these categories.

Note that, for all of the categories considered, both the entering and exiting brands had higher nutrition index values than the category as a whole. These higher values suggest that changes in food products offered for sale at the supermarket are among brands that are more nutritious than average. While findings reported by Frazão and Allshouse (1996) and others show that the number of new nutritionally improved versions of products is growing, the results shown here suggest that this expansion may be offset by exits of products with better than average nutrition profiles. This is reflected in the mean index values, which exhibited little change in the nutritional quality of food products offered for sale. It is unclear whether the pattern of product churn found here is common or may reflect a period of post-NLEA instability.

Summary of Findings: Food Products Offered for Sale

The calculated nutritional quality indexes were used to measure changes in the mean nutritional quality of food product offerings in five selected food product categories: entrees, salted snacks, and cookies in 1994-97, soup in 1995-97, and processed meats and bacon in 1992-97. For entrees and cookies, the changes in the mean values of the indexes were negative, suggesting that the average nutritional quality of these foods decreased from 1994-97, but the changes were statistically insignificant. In turn, for soup in 1995-97, salted snacks in 1994-97, and processed meats and bacon in 1992-97, the changes in the indexes were positive, suggesting that the average nutritional quality of these products increased, but here again, the changes were statistically insignificant. In the processed meats and bacon category, increases in nutritional quality were largest in 1992-93 (pre-NLEA period) and in 1995-97 (post-NLEA period). The magnitude of the changes were comparable in both periods, suggesting that, at least for processed meats and bacon, the pace and direction of nutritional quality change was the same before and after the introduction of the NLEA. However, the changes in the nutrition indexes were statistically insignificant for processed meats and bacon.

The analysis of changes in the indexes was extended by investigating changes in individual nutrients and the nutritional quality of entering and exiting food product brands. The results reveal similar trends and support the index analysis. The mean values for individual nutrient levels in soup, salted snacks, and processed meats and bacon showed changes in a desirable direction. The levels of undesirable nutrients, such as fat, saturated fat, and cholesterol, decreased, and the levels of desirable nutrients, such as vitamins, calcium, and iron, increased. However, most of the changes were found to be statistically insignificant. The only significant changes at the 95-percent level were in saturated fat and vitamin A in salted snacks and in carbohydrates, vitamin A, calcium, and iron in processed meats and bacon. At the 90-percent level the only significant changes were in vitamin A in soup, fat in salted snacks, fiber and protein in cookies, and saturated fat and protein in processed meats and bacon.

For all of the food categories considered, both the entering and exiting brands had higher index values than their categories as a whole, suggesting that, in the immediate post-NLEA period, entry and exit was taking place among brands that were more nutritious than average. This is consistent with the overall finding of little change in the average nutritional quality of food product offerings in the years studied.