TRENDS AND APPLICATIONS

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The Effects of Nutrition Label Comparison Baselines on Consumers' Food Choices

Recent legislative changes in the European Union have mandated nutrition labeling for the majority of pre-packaged foods. This research compared effects of several nutrition labeling formats on consumers' food choices (i.e., the nutrition table, GDA 100 g/ml, and GDA portion). We primarily focused on whether nutrition label information was standardized to a fixed or varying comparison baseline. Fixed baselines (e.g., 100 g/ml) allow consumers to make direct, relative comparisons of products, while varying baselines (e.g., portion size) often require consumers to undertake complex mathematical calculations. Findings suggest that consumers' food choices are likely to be healthier when nutrition label information is presented on a fixed baseline. Gender was found to moderate these effects such that women made healthier choices—but only when the nutrition label baseline was fixed. Thus, the type of comparison baseline is an important characteristic of nutrition labels for public policymakers, public health officials, and academic researchers to consider.

The European "Food Information to Consumers" Regulation (No. 1169/2011) went into effect in 2014 and will mandate the nutritional declaration of the "Big 7" on the back of all food and drink packages by December 2016. This includes the absolute values of a food product's energy, fat, saturated fat, carbohydrates, sugars, protein, and salt content. The legislation further requires that this nutrient information be expressed in either a "per 100 g/ml" format (i.e., every 100 g or 100 ml of the product contains, etc.) or a "per portion" format (i.e., a portion of 150 g of the product contains, etc.) (European Commission 2011).

Prior research suggests that nutrition labeling such as this may be able to assist consumers in making healthier, more informed decisions.

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However, most existing nutrition labeling studies have only compared the effects of different labels on consumer food choices (e.g., Guideline Daily Amounts [GDA] vs. traffic lights vs. healthy stars), thereby overlooking how alternative versions of the same, single labeling format such as the GDA (e.g., GDA 100 g/ml vs. GDA per portion) might have disparate effects on consumer food choices (for reviews see Hieke and Taylor 2012; Hieke and Wills 2012).

With this in mind, the purpose of this research is to examine the potential differential effects of the nutrition table and two alternative versions of the popular GDA nutrition label (i.e., the GDA 100 g/ml and GDA portion formats, as described later) on consumers' food choices. We primarily focus on whether nutrition label information is standardized to a fixed or varying comparison baseline as an important point of differentiation among these three tested labels (i.e., whether or not the label information allows for *direct* healthfulness comparisons of products without mathematical calculations, as discussed in detail subsequently). We also consider the moderating impact of gender.

BACKGROUND

Tested Nutrition Label Formats

The GDA nutrition label was created as a means of communicating the recommended amount of nutrients a person should be eating in a day (GDA 2013a). It provides consumers not only with absolute values of calories, sugars, fat, saturated fat, and salt, but also with the proposed daily reference quantities of each nutrient in percentages based on a daily caloric intake of 2,000 kcal. These values can be expressed in either a "per 100 g/ml" or a "per portion" format. Numerous food companies throughout Europe voluntarily provide GDA nutrition labels on the front or back of their food packages (see GDA 2013b; Hersey et al. 2013).

We also examine the effects of the nutrition table in the present research. It is presently the most widespread back-of-package nutrition labeling scheme in the EU (EUFIC 2012), and is very similar in nature to the Nutrition Facts panel in the United States. The nutrition table has been mandatory since 1990 whenever nutrition- and health-related claims are made on a food product (European Commission 1990). It offers the absolute values of calories, sugars, fat, saturated fat, salt, carbohydrates, cholesterol, and protein in a "per 100 g/ml" format only. Unlike the two tested GDA formats (GDA 100 g/ml and GDA portion), no additional evaluative indications such as percentages are provided.

Nutrition Label Comparison Baselines

The nutrition information provided in a nutrition label can be standardized to either a fixed or a varying comparison baseline. A fixed comparison baseline remains consistent and uniform across all products, and allows consumers to directly and easily compare the relative healthfulness of multiple food products without the need for complex mathematical calculations. For example, consumers can easily and directly compare the absolute calorie and nutrient values for many different products when they are presented on the same fixed baseline of 75 g (e.g., product A has 3 g of sugar per every 75 g of the product; product B has 5 g of sugar per every 75 g of the product). Of the three label formats tested here, two formats offer nutrition information that is standardized to a fixed baseline of 100 g/ml (the nutrition table and the GDA 100 g/ml format).

In contrast, a comparison baseline that varies across products makes direct comparisons of food products considerably more difficult. The GDA portion format is the only label tested here that offers nutrition information that is standardized to a baseline that can vary greatly (e.g., product A has 285 mg sodium per every 110 g portion; product B has 160 mg sodium per every 150 g portion). In this case, consumers must perform complex numerical calculations to convert all the calorie and nutrient information to a common baseline in order to make direct comparisons among the alternatives. We specifically consider these comparison baseline differences in the development of our hypotheses in the following section.

HYPOTHESES DEVELOPMENT

Consumers can experience a number of difficulties when dealing with numerical health and nutrition information. They possess only a limited capacity to process information before cognitive overload leads to poorer decision-making (Malhotra 1982). As a result, consumers tend to simply process and use nutrition information in the format in which it is provided to them (Klopp and MacDonald 1981; Levy, Fein, and Schucker 1996). This leads many consumers to merely interpret the absolute values of nutrients, rather than undertaking the necessary calculations needed to accurately understand the values relative to an appropriate baseline (Levy, Fein, and Schucker 1996). This may result in poorer (i.e., unhealthier) food choices, especially in information-rich supermarket settings where consumers make decisions quickly (Grunert 2006) in the presence of numerous brands and varying portion sizes (Bryant and Dundes 2005). Thus, simpler label formats that reduce the time and cognitive effort needed to process nutrition information are thought to be most influential in grocery store environments (Feunekes et al. 2008; Gerrior 2010).

Considering these points cumulatively, we expect nutrition information that is presented along a common, fixed baseline (the nutrition table and GDA 100 g/ml label) to better facilitate healthy in-store choices compared to information that is presented on a baseline that varies (the GDA portion label). Therefore, in an experimental shopping scenario where the healthfulness of a consumer's choices is represented by the healthfulness of his or her shopping basket, we predict the following:

H1: Consumers will have healthier (unhealthier) shopping baskets when nutrition label information is standardized to a fixed (varying) comparison baseline.

We also expect gender differences to emerge in choice behavior such that females make overall healthier choices than males. Previous research has shown that females are more likely than men to comply with dietary recommendations and to choose foods that align with dietary guidelines when shopping (Bates et al. 2009; Worsley and Crawford 1986). Additionally, compared to males, females tend to perceive nutrition as more important when food shopping, use food labels more often, and are more likely to let nutrition labels ultimately influence their choice decisions (Campos, Doxey, and Hammond 2011; Drichoutis, Lazaridis, and Nayga 2006; Mandal 2010; Nayga 1997).

However, we suggest that these gender differences likely depend on whether or not the available nutrition information can be easily and efficiently integrated into consumers' shopping decisions. That is, nutrition label information that is standardized to a fixed baseline should assist women in their proactive attempts to use nutrition labels to make healthier choices. In contrast, nutrition information that is based on a varying baseline should make healthy choices considerably more difficult—especially in a shopping environment where numerous decisions must be made using dissimilar comparison baselines for a number of different products and categories of varying healthfulness. Therefore, women may not make healthier choices than men when presented only with this type of inconsistent information. More formally, we predict the following:

H2: When nutrition label information is standardized to a fixed comparison baseline, females will have healthier shopping baskets than males. However, when nutrition *label information is standardized to a varying comparison baseline, gender will have no effect on shopping basket healthfulness.*

METHODOLOGY

Sample and Procedures

A mixed sample of 276 students and adults from a university subject research pool in Europe was recruited for this study. Approximately 61% of this sample was female, and ages ranged between 20 and 27 years. Respondents were randomly assigned to one of four treatment groups which varied in their format of nutrition information provision: no label (only a list of ingredients), nutrition table (similar to the NFP in the United States), GDA 100 g/ml, and GDA portion. These formats are presented in Figure 1. As previously mentioned, the nutrition table and the GDA 100 g/ml label both offer nutrition information that is standardized to a fixed baseline (both 100 g/ml), whereas the GDA portion format offers information that is standardized to a varying baseline (portion size). By including the nutrition table, we were able to assess whether any differences exist in the effects of two labels that both have fixed baselines, but differ slightly in the information they offer. A list of ingredients was chosen as the no-label condition to add realism since over half of consumers consider ingredient lists when buying packaged foods and beverages (IFIC 2012).

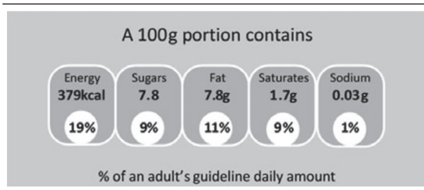
An online shopping basket-method was used to record respondents' food choices. Respondents were offered products from seven food groups (i.e., cereals, fruits and vegetables, dairy, meat and fish, drinks, oils and fats, and sweets and snacks). Up to four different categories were offered within each of the seven food groups (e.g., for the dairy food group, respondents could shop within the categories of milk, cheese, and/or yogurt). These categories were previously validated by a small committee of nutrition experts as those best suited to cover the average dietary range of products within each larger food group. Lastly, within each category there were three to four individual food items for respondents to ultimately choose from (e.g., within the milk category, respondents could choose either whole milk, 1% milk, or skim milk). One food item within each category was objectively healthier, one product was relatively less healthy, and the remaining one (or two) item(s) were moderately nutritious, as pre-determined by the nutrition committee. Committee members considered the overall healthfulness of a product as part of a balanced daily diet when making these decisions, rather than specific levels of particular nutrients. All decisions had to be unanimous in order for a product to be included

FIGURE 1
Nutrition Label Formats

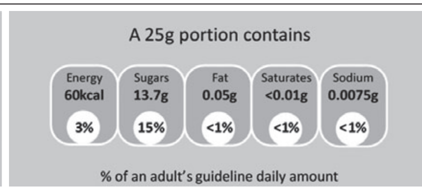
No Label Condition: Ingredients List	*Nutrition Table*
Ingredients: Peas, carrots, cauliflower, butter, corn, parsley, cooking salt, sugar, starch, herbs, natural aroma (contains milk)	**Nutrition Facts** Serving Size 100g

Nutrition Facts	
Calories	1762 kJ 418 kcal
Protein	6.5 g
Carbohydrates Sugars	71 g 33 g
Total Fat Saturated Fat	12 g 6.2 g
Cholesterol	5.0 g
Sodium	0.21 g

GDA 100g/ml



GDA Portion



in the study. A number and variety of different categories, as well as a number and variety of individual food items within each category, were purposefully offered to account for variance in personal consumption and to limit forced decision-making[1] (see Appendix 1).

Respondents were presented with an online photograph of each individual food item, as well as each item's nutrition information in the label format corresponding to their treatment group (or a list of ingredients for each item in the no-label condition). They were then asked to choose at least one food item to purchase from each of the larger seven food groups, resulting in a minimum of seven food item choices. However, respondents could choose up to one item from every available category, resulting in a potential maximum of 18 food item choices across all available categories. Any indication of price, well-known brand names, designs/symbols, or general product information was eliminated prior to exposure to respondents in order to control for potential confounding influences on participants' choices. Participants were never explicitly or implicitly asked to consider

1. Vegetarians were also given the opportunity to opt out of the meat and fish category to limit forced decisions.

the healthfulness of the individual items, categories, or food groups in their choice decisions in an attempt to minimize any demand effects or social desirability biases.

Dependent Measure

The dependent variable "shopping basket healthiness points" was calculated as each participant's total score based on his/her choices of food items. Three points were awarded when the healthiest item within a category was selected, two points were awarded when a moderately nutritious item was chosen, and one point was awarded when the unhealthiest item was selected. After calculating an average score for each of the seven food groups for every respondent, each respondent's overall average point total was then standardized to account for any potential differences in the number of food items that respondents chose. As such, each respondent ended up with a standardized shopping basket healthiness point score ranging from 1 to 3 where higher scores indicate overall healthier shopping baskets.

RESULTS

Manipulation Check

As expected, results from a one factor analysis of variance (ANOVA) revealed a significant main effect of the manipulated independent variable (i.e., labeling systems) on the healthfulness of respondents' choices (i.e., basket healthiness points) ($F_{basket} = 23.39$, $p < .001$) ($\eta^2 = .206$, adjusted: $\omega^2 = .214$). This suggests a successful manipulation, so we now turn to our specific tests of predictions where we consider the direct and interactive effects of the labeling systems' manipulation and gender.

Tests of Predictions

As indicated in Table 1, the treatment groups (labeling systems) had a significant effect on respondents' basket healthiness points ($F(3) = 22.29$, $p < .001$). Referring to Figure 2, contrasts reveal that respondents in the varying baseline GDA portion condition accumulated significantly less basket healthiness points than did respondents in the fixed baseline nutrition table condition ($M_{GDAportion} = 2.23$, $SD = .38$ vs. $M_{TABLE} = 2.38$, $SD = .38$, $p < .01$, Cohen's $d = .39$) and in the fixed baseline GDA 100 g/ml condition ($M_{GDAportion} = 2.23$, $SD = .38$ vs. $M_{GDA100} = 2.34$, $SD = .40$, $p < .05$, Cohen's $d = .28$). Accordingly, H1 is supported.

TABLE 1
Effects of Labeling Format and Gender on Shopping Basket Healthiness Points

	F Value	*p* Value
Model	12.357	.000***
Labeling system	22.289	.000***
Gender	9.348	.002**
Labeling system*Gender	1.275	.283
$R^2 = .245$ (adj. $R^2 = .225$)		

***$p < .001$; **$p < .01$; *$p < .05$.

Referring now to Figure 3, the overall gender by labeling format interaction was not significant, but the follow-up contrasts of interest show that females accumulated significantly more basket healthiness points than males in both the fixed baseline nutrition table condition ($M_{\text{WOMEN}} = 2.48$, $SD = .36$ vs. $M_{\text{MEN}} = 2.29$, $SD = .39$, $p < .04$, Cohen's $d = .51$) and the fixed baseline GDA 100 g/ml condition ($M_{\text{WOMEN}} = 2.46$, $SD = .37$ vs. $M_{\text{MEN}} = 2.21$, $SD = .43$, $p < .01$, Cohen's $d = .62$). However, females in the varying baseline GDA portion condition accumulated significantly less basket healthiness points than other females in the fixed baseline nutrition table and GDA 100 g/ml conditions (both p's $< .01$), resulting in no significant difference in basket healthiness points between males and females in the varying baseline GDA portion

FIGURE 2
Effects of Label Format on Shopping Basket Healthiness Points

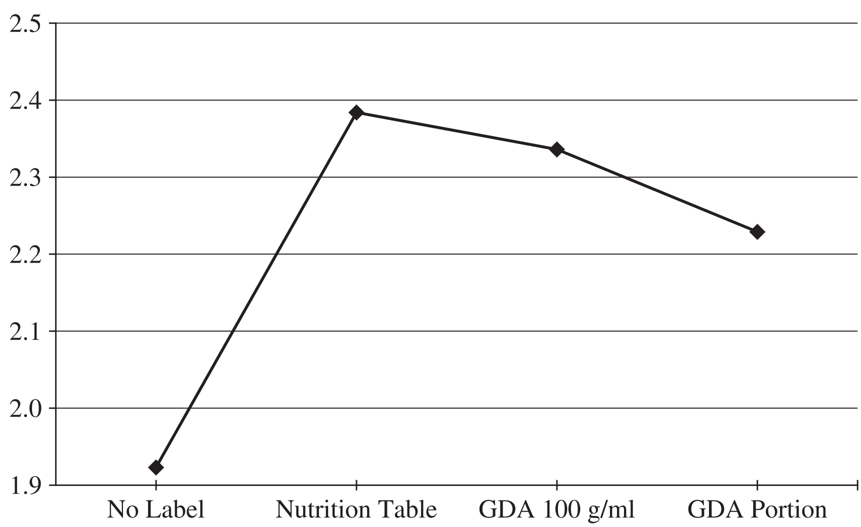
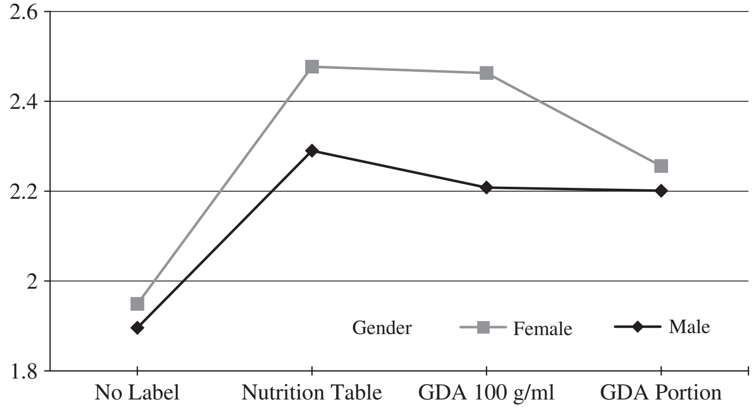


FIGURE 3
Effects of Label Format and Gender on Shopping Basket Healthiness Points



condition ($M_{\text{WOMEN}} = 2.26$ vs. $M_{\text{MEN}} = 2.20$, $p > .10$). Therefore, H2 is supported.

GENERAL DISCUSSION

The present research examined the differential effects of several popular and practically relevant nutrition labeling formats (nutrition table, GDA 100 g/ml, and GDA portion) on consumers' food choices. A key proposed difference in these label formats was whether the nutrition label information was standardized to a fixed baseline (as seen in the nutrition table and GDA 100 g/ml formats) or a varying baseline (as seen in the GDA portion format). In support of this proposition, our findings show that respondents' food choices were healthier, overall, when nutrition label information was presented on a fixed, rather than varying, baseline. We further considered the moderating role of gender on these label effects. As expected, females made healthier choices compared to males when the baselines were fixed. However, females who were presented with information based on a varying baseline (portion size) made significantly less healthy choices than females in both of the fixed baseline conditions, resulting in no gender differences in the varying baseline condition (as shown in Figure 3). The public policy and consumer welfare implications of this research follow below.

PUBLIC POLICY AND CONSUMER WELFARE IMPLICATIONS

Nutrition labeling initiatives continue to be widely debated by policymakers, health officials, and researchers, alike (Burton et al. 2015). The results of this research offer important points for these constituencies to consider—particularly with respect to the recent legislation in the European Union (EU) which will soon mandate the nutritional declaration of the "Big 7" on the back of all food and drink packages. In general, our findings suggest that nutrition label formats with a fixed baseline may lead to overall healthier food choices than label formats with a varying baseline. With regards to the specific case of the GDA label, our results suggest that the fixed baseline GDA 100 g/ml format is likely to have a more positive impact on consumer health than the varying baseline GDA portion format, as the former was shown to lead to healthier choices. More broadly, these findings have implications that also extend beyond the EU and can apply to any country which uses (or is considering using) nutrition labeling systems that do not have fixed baselines.

However, if public policymakers choose to implement a nutrition label with a fixed baseline, an additional decision they would then face is which specific *type* of fixed baseline label format to use. For example, should percentages be presented in conjunction with the absolute values of nutrients? To provide insight on this, we refer to differences in the effects of the nutrition table and GDA 100 g/ml formats on consumers' choices observed in this study. While both labels present nutrient values on a fixed baseline (both 100 g/ml), the GDA format additionally offers evaluative information in the form of each nutrient's percentage of an adult's guideline daily amount. Results indicate that these two formats did not differ in their influence on consumers' food choices. This finding can be interpreted several ways: (1) the additional evaluative information in the GDA format has no incremental benefit for consumers, or (2) such evaluative information can be offered without having negative implications for consumers. The latter point may be especially pertinent to public policy and consumer welfare initiatives; it suggests that an additional, yet different, type of information can be included on fixed baseline nutrition labels that may provide extra benefits to some consumers without resulting in negative consequences for others (e.g., information overload).

Lastly, careful segmentation will be critical in enhancing any potential positive effects of nutrition labels on the healthfulness of consumers' food choices. Our findings reveal that males made significantly less healthy food choices than females, overall, when presented with nutrition information on a fixed baseline (in both the nutrition table and GDA 100 g/ml formats). Policymakers and public health officials should seek to attenuate this gender discrepancy through educational and promotional efforts designed to encourage males, specifically, to make healthier choices. Future studies should more fully assess what factors may lead to these differences and how they can best be accounted for.

LIMITATIONS AND CONCLUSION

Several limitations of this research should be noted that may lead to other potentially fruitful areas for future research. First, a mixed sample consisting of students and adults was utilized, thus possibly limiting the generalizability of results. Additionally, while laboratory experiments offer relatively controlled settings, participants still acted in a limited, artificial environment. It should also be noted that while we standardized respondents' shopping basket scores, the same score could possibly be reached multiple ways (e.g., different point amounts stemming from different categories). Thus, these results should be interpreted with caution. Our research also lacks access to secondary data, such as purchase behavior, and respondents' choices were limited only to the products and categories made available to them. Future research should observe the effects of the tested label formats on the actual purchasing behavior of adult samples in natural shopping environments. Also, respondents were not presented with a list of ingredients in the nutrition table or GDA label conditions, so it is possible that the observed effects stemmed from more than just the provision of nutrition information. Future research should assess any potential interactions between nutrition label formats and ingredient lists for more clarification and should assess the effects stemming from more controlled tests of these labels.

In conclusion, the current research indicated that respondents' food choices were healthier, overall, when nutrition label information was presented on a fixed, rather than varying, baseline (and further that gender moderated these effects). These findings speak to the documented need for policymakers to better understand the effects of standardized information disclosures on consumer welfare (Moorman, Du, and Mela 2005), and answer more specific calls for research on the usefulness of GDA information in supermarket settings (Hassan, Shiu, and Michaelidou 2010). The timely results of this research may be used to inform the ongoing debate about nutrition labeling, and will likely be of interest to public policymakers, public health officials, consumer welfare advocates, and researchers as a result.

APPENDIX 1
Study Products and Nutrient Levels

Product	*Nutrient*	*Nutrient Levels (per 100 g/ml)*	*GDAs (per 100 g/ml)*	*GDAs (per portion)*
Cereal 	Energy	379 kcal	379 kcal (19%)	228 kcal (11%)
	Fat	7.8 g	7.8 g (11%)	4.7 g (7%)
	Sugars	13 g	13 g (14%)	7.8 g (9%)
	Sat. fat	1.7 g	1.7 g (9%)	1.0 g (5%)
	Sodium	0.03 g	0.03 g (1%)	0.018 g (1%)
				(Portion is 60 g)
Frozen vegetables 	Energy	85 kcal	85 kcal (4%)	127 kcal (6%)
	Fat	6.1 g	6.1 g (9%)	9.2 g (13%)
	Sugars	3.4 g	3.4 g (4%)	5.1 g (6%)
	Sat. fat	3.9 g	3.9 g (20%)	5.9 g (30%)
	Sodium	0.3 g	0.3 g (13%)	0.5 g (22%)
				(Portion is 150 g)
Cooked ham 	Energy	281 kcal	281 kcal (14%)	42 kcal (2%)
	Fat	25 g	25 g (36%)	3.8 g (5%)
	Sugars	1 g	1 g (1%)	0.2 g (<1%)
	Sat. fat	9.8 g	9.8 g (49%)	1.5 g (7%)
	Sodium	1 g	1 g (42%)	0.15 g (6%)
				(Portion is 15 g)
Cheese 	Energy	260 kcal	260 kcal (13%)	91 kcal (5%)
	Fat	16 g	16 g (23%)	5.6 g (8%)
	Sugars	0.05 g	0.05 g (0%)	0.02 g (<1%)
	Sat. fat	10.9 g	10.9 g (55%)	3.9 g (19%)
	Sodium	0.5 g	0.5 g (25%)	0.21 g (8%)
				(Portion is 35 g)
Butter 	Energy	281 kcal	281 kcal (14%)	42 kcal (2%)
	Fat	25 g	25 g (36%)	3.8 g (5%)
	Sugars	1 g	1 g (1%)	0.2 g (<1%)
	Sat. fat	9.8 g	9.8 g (49%)	1.5 g (7%)
	Sodium	1 g	1 g (42%)	0.15 g (6%)
				(Portion is 8 g)
Sweet spread 	Energy	240 kcal	240 kcal (12%)	60 kcal (3%)
	Fat	0.2 g	0.2 g (0%)	0.05 g (<1%)
	Sugars	54.7 g	54.7 g (61%)	13.7 g (15%)
	Sat. fat	0.02 g	0.02 g (0%)	<0.01 g (<1%)
	Sodium	0.03 g	0.03 g (1%)	0.0075 g (<1%)
				(Portion is 25 g)

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