Oxalate Content of Food: A Tangled Web

Kyrollis Attalla, Shubha De, and Manoj Monga

OBJECTIVE To account for variations in dietary oxalate content in resources available to hyperoxaluric patients. Our objective is to examine the heterogeneity of the oxalate content reported across various Web-based sources and smartphone applications.

METHODS A search of "oxalate content of food" was performed using the Google search engine. Smartphone applications were identified by their ability to assess oxalate content. Oxalate contents were obtained, and common foods were selected for comparison. Food groups were compared to better understand how patients are guided when using these references to manipulate their diet.

RESULTS Thirteen sources were identified, and 8 sources (6 Web sites and 2 applications) were used to construct figures for comparison of commonly listed foods. Oxalate content was extremely variable between various sources. Fruits with the widest observed range of oxalate included oranges (2.07-10.64 mg/100 g) and bananas (0-9.9 mg/100 g). Among vegetables, the oxalate contents of spinach (364.44-1145 mg/100 g), rhubarb (511-983.61 mg/100 g), and beets (36.9-794.12 mg/100 g) were most variable. Among nuts, the oxalate content of peanuts ranged from 64.57 to 348.58 mg/100 g, and pecans ranged from 4.08 to 404.08 mg/100 g.

CONCLUSION Wide variations exist in the reported oxalate content of foods across several Web-based sources and smartphone applications, several of which are substantial and can have a sizable impact on the construction of a low oxalate diet. As dietary counseling has proven benefits, patients and caregivers should be aware of the heterogeneity that exists in the reported oxalate content of foods. UROLOGY 84: 555–560, 2014. © 2014 Elsevier Inc.

As the most common type of kidney stone, the occurrence of calcium oxalate stones are in part attributable to urinary oxalate content.[1] Because the urine concentration of oxalate is much lower than that of calcium, the crystallization of calcium oxalate is far more sensitive to changes in oxalate concentration than that of calcium.[2] Liver synthesis and the absorption of dietary calcium are primarily responsible for the oxalate found in urine, and because dietary oxalate can account for 10%-45% of oxalate found in urine,[2,3] reduction in oxalate intake is a common preventive strategy for calcium oxalate stone formers.

With an increasing number of patients using Internet-based medical resources, many reference sites are available for people interested in adjusting their oxalate consumption. Stone formers adhering to a low oxalate diet may be confused by the inconsistency in oxalate values for a single food across Web sites. This is also a challenge for health-care professionals as oxalate levels can vary based on analytical techniques, cultivar biological variations, time of harvest, and growing conditions.[4]

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From the Glickman Urologic and Kidney Institute, Cleveland Clinic, Cleveland, OH
Reprint requests: Manoj Monga, M.D., The Glickman Urologic and Kidney Institute, Cleveland Clinic, 9500 Euclid Avenue/Q10, Cleveland, OH 44195. E-mail: endourol@yahoo.com
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Because no gold standard oxalate reference database exists, large variations in the reported oxalate contents could impact the counseling and subsequent compliance of hyperoxaluric patients. Therefore, our objective is to examine the heterogeneity of the oxalate content of foods reported across various Web-based sources and smartphone applications. Food groups were compared to better understand how patients are guided when using these references to manipulate their diet.

METHODS

Recent reports suggest that 77% individuals seeking online health advice start at search engines.[5] Simulating patients searching the Internet for information regarding a low oxalate diet, a Web search of "oxalate content of food" was conducted using the Google search engine, yielding 9 Web sites. Duplications were excluded from further analysis. Similarly, a search of applications for the iPhone or iPad was conducted and applications displaying or calculating the oxalate content of foods were purchased and downloaded.

Oxalate contents were obtained from each source, and foods that were common to most sources were selected for comparison. All foods were converted to milligrams of oxalate per 100 g of food, so that oxalate measurements could be compared across all sources. Some sources reported a range of oxalate values for a food item. When ranges of oxalate content were identified, ensuring the most conservative diet was followed, the highest value of the stated range was used. Descriptive statistics were used to compare the oxalate values of foods across the identified sources.

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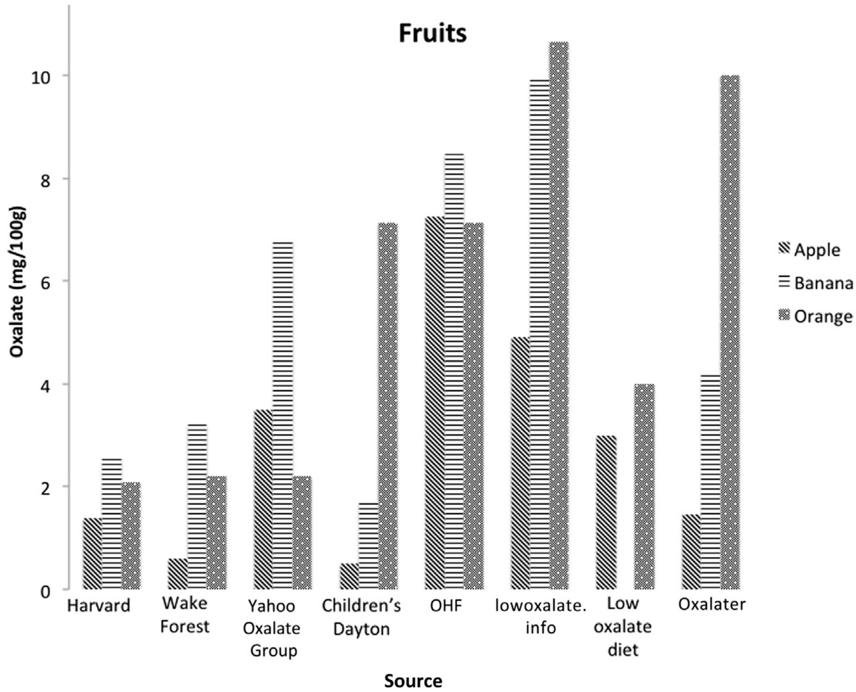

Figure 1. Oxalate content of fruits (mg/100 g).

RESULTS

A total of 13 sources were identified: 10 Web sites and 3 smartphone applications. One site, "Women's Wellness Place," contained a chart identical to the chart found in "Northwoods Urology" and was excluded from the study. The smartphone application search yielded 3 applications; one application, "iOxalate," identified foods as either "high," "medium," or "low" in oxalate content and gave no measured value, and was excluded from the study. A fitness and nutrition group requiring a free subscription, "Trying Low Oxalates," was found and provided subscribers with diet advice and a comprehensive list of foods and oxalate values. Of the remaining 11 sources available for analysis (9 Web sites and 2 applications) listed in Appendix 1, 8 sources (6 Web sites and 2 applications) were used to construct figures for comparison because of the commonalities in foods between them.

Most Web sites used milligrams of oxalate per 100 g of food source as a common unit. The measured oxalate found in Harvard's Web site, the "Trying Low Oxalates" group, and the "Oxalater" application reported values in milligrams per serving of food, and required conversion to mg/100 g, necessitating reference to establish the conversion of milligrams of oxalate content in a "serving" to mg/100 g. "Trying Low Oxalates" provided users with the weight (in grams) of common serving sizes of foods and was used as the reference for conversions.

Four dietary groups (fruits, Fig. 1; vegetables, Fig. 2; nuts, Fig. 3; dairy and grain, Fig. 4) were compared across 8 sources. Oxalate content was found to be heterogeneous across virtually all food items compared between sources. Among fruits with the widest observed range of oxalate, the oxalate content of oranges ranged from 2.07 to 10.64 mg/100 g, and the oxalate content of bananas ranged from 0 to 9.9 mg/100 g. Among vegetables, the oxalate content of spinach ranged from 364.44 to 1145 mg/100 g, that of rhubarb ranged from 511 to 983.61 mg/100 g, and that of beets ranged from 36.9 to 794.12 mg/100 g. Among nuts, the content of peanuts ranged from 64.57 to 348.58 mg/100 g and pecans ranged from 4.08 to 404.08 mg/100 g. The oxalate content of milk and rice were low (<10 mg/100 g); however, values were also found to be inconsistent.

COMMENT

Dietary oxalate reduction is a common practice in the management of hyperoxaluric stone formers. After reviewing several online sources and smartphone applications, the heterogeneity in dietary oxalate content was found to vary widely among certain foods. Some foods such as spinach, rhubarb, and peanuts are consistently identified as having high levels of oxalate and are easily identified by users as the ones to be avoided. However, finding variable oxalate measurements of many other foods and knowing what foods can be included in a low oxalate diet can make proper diet modification challenging.

One of the challenges faced with dietary counseling is that individual foods, preparation techniques, and testing methods can impact oxalate content. Oxalate quantification has been prone to errors in both extraction and measurements. Existing in soluble (potassium oxalate) and insoluble (calcium oxalate and magnesium oxalate) forms can affect both laboratory processing and gut