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Discussion

Report: Release of the International Life Sciences Institute Crop Composition Database Version 5

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ABSTRACT

The International Life Sciences Institute Crop Composition Database (ILSI-CCDB) Version 5 was released to the public in October 2014, and is an open-access source of comprehensive nutritional composition data for six conventionally bred crops (canola, cotton, field corn, rice, soybean, and sweet corn). Some notable features include a substantially greater amount of data (842,500 data points, a seven-fold increase compared to Version 4) as well as data for three additional crops (canola, rice, and sweet corn). For each additional crop, the appropriateness of each nutritional component and analytical methodology were carefully evaluated by a working group consisting of members representing academia, government agencies, and the agricultural and food industries. Rigorous data validation and quality control processes were established. Literature references for the analytical methods represented in the database were standardized and consolidated, allowing faster data upload for data providers and increased clarity for database end-users. Data quality checks were conducted on all data to identify and correct any errors that may have occurred during upload and subsequent handling in the database. The result of these efforts is a database with increased utility and ease of use that provides a high quality representation of variability in crop nutritional composition.

1. Introduction

The International Life Sciences Institute Crop Composition Database (ILSI-CCDB)[1] is an open-access database that is managed by the International Life Sciences Institute Research Foundation through its Center for Safety Assessment of Food and Feed (CSAFF), and contains a compilation of nutritional composition data for six conventionally bred crops. The ILSI-CCDB includes a comprehensive profile of nutrients, bioactive substances, and secondary

Abbreviations: ILSI-CCDB, International Life Sciences Institute Crop Composition Database; CSAFF, Center for Safety Assessment of Food and Feed; OECD, Organisation for Economic Co-operation and Development; AOAC, Association of Analytical Communities; AACC, American Association of Cereal Chemists; CTA, Crop/Tissue/Analyte; UOM, units of measure; LOQ, limit of quantitation; IQR, interquartile range.

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[1] http://www.cropcomposition.org.

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metabolites that are considered to be relevant to human and animal nutrition for each of these crops (OECD, 2002, 2004a,b, 2011, 2012). The data were compiled from numerous submitters that are actively engaged in agricultural research (Alba et al., 2010; Ridley et al., 2004) and have met rigorous and clearly defined experimental design, sample collection, sample analysis, and data acceptance criteria. All data were derived from crop samples generated in controlled field trials, and all sample analyses were conducted using internationally accepted and validated methodologies.

The published data have been standardized and can be comprehensively extracted according to user-selected search criteria for use in academia, by government agencies, in the agricultural and food industries, and by the general public. Database queries can be filtered using metadata such as the field trial year, field trial location, and the analytical method associated with each data point. To allow better understanding of the natural variation of nutritional components in crop tissues, the database also provides a measure of statistical dispersion for individual analytes (i.e., ranges) and central tendency statistics (i.e., mean values) (Ridley et al., 2004).

The ILSI-CCDB is an internationally recognized database that is used extensively by researchers across many scientific disciplines (e.g., plant, animal, and food sciences) for various research needs (Kitta, 2013). Over 80,400 unique visits to the database website were logged within one year (November 2014 through October 2015) from users in 127 countries. End-use of the database spans a wide range of applications, including methodology comparisons (Mitchell et al., 2015), assessment of natural variation (Berman et al., 2010; Lundry et al., 2013), nutritional studies (Flachowsky et al., 2005; Hyun et al., 2005), and crop breeder identification of nutritional components that are of particular interest (Jaradat and Goldstein, 2014; Venkatesh et al., 2015). The database also provides context to nutritional composition assessments of new crop varieties developed through conventional methods or agricultural biotechnology, by providing information on the inherent natural variation in the nutritional composition of conventionally bred crops.

Projects such as the ILSI-CCDB are part of the ILSI Research Foundation's mission to improve environmental sustainability and human health by advancing science to address real world problems (ILSI, 2015b). The ILSI-CCDB is managed by a working group consisting of experts representing academia, government agencies, and the agricultural and food industries. The working group is coordinated by a program manager who ensures the working group activities are conducted according to ILSI Research Foundation ethics and guidelines.[2] The CCDB program manager, as the only member of the working group that is an employee of the ILSI Research Foundation, serves as the database administrator and therefore has sole access to aspects of the data that are confidential in nature (e.g., name of data submitter, plant varietal name).

Working group members provide relevant scientific expertise and technical understanding to direct periodic maintenance, updates, and improvements to the database including verification of established acceptability criteria for all new data entered into the database, publishing of newly available data, and incorporation of new crops into the database. Additional input from external experts is requested as needed. Additionally, the ILSI-CCDB working group is engaged in outreach efforts to identify new data providers and promote the database to end-users.

[2] ILSI. Retrieved November 11, 2015 from http://www.ilsi.org/Pages/Scientific-Integrity.aspx.

The previous version of the ILSI-CCDB, Version 4, introduced a number of improvements to the database software and hardware that provided a more user-friendly interface, significantly faster search speeds, added security, and user-customizable search outputs downloadable in multiple electronic file formats (Alba et al., 2010). These improvements were designed to better meet the diverse needs of end-users, providing more flexibility in output report formatting along with the option to view and/or output composition data in various units of measure. The improved performance, stability, and accuracy established in ILSI-CCDB Version 4 provided a solid foundation to enable the addition of new data on a much larger scale in future version releases. The current version of the database (Version 5), released October 2014, contains a substantially greater amount of data, with the addition of three new crops and a seven-fold increase in the total number of data points.

These features, along with the relative convenience of keeping the database up-to-date as future data become available, makes the ILSI-CCDB a valuable resource for understanding the inherent natural variability of nutritional composition in cultivated crops. In this paper, we discuss the changes and improvements contained in the ILSI-CCDB Version 5 compared to the previous version.

2. Summary of ILSI-CCDB version 5

With the release of Version 5, the number of data points contained in the ILSI-CCDB increased to 842,500 data points, a 7-fold increase compared to the previous version (Table 1). New data were added for the three crops already included in the database (field corn, soybean, and cotton), and also for three additional crops (canola, rice, and sweet corn). Covering major growing regions for each crop over a large number of years (Table 2), the ILSI-CCDB Version 5 is a resource that provides a representation of the inherent natural variability of nutritional composition in these crops.

Because a principle purpose of the ILSI-CCDB is to be a resource for understanding the natural variability of nutritional composition in major crop commodities, one objective of the database update was to include data from additional crops. Canola, rice, and sweet corn were prioritized by the ILSI-CCDB working group for inclusion in the Version 5 release based on the quality and quantity of data available. For each crop, a sub-team of experts was established from the working group members to determine the relevant technical requirements and to evaluate and approve the appropriateness of proposed nutritional components and analytical methodologies.

2.1. Canola

For canola, the data available for the Version 5 release were derived from *Brassica napus* containing erucic acid content of less than 2%. However, the common name "canola" also refers to *Brassica rapa* and *Brassica juncea* varieties, as well as low erucic acid and low glucosinolate rapeseed and conventionally bred varieties with modified oil profiles. To ensure consistency of reporting, the OECD (2011) definition of low erucic acid rapeseed (<2% erucic acid in the oil and <30 μmol/g glucosinolates in seed/meal) was adopted for *B. napus* reported in the ILSI-CCDB. As additional canola data is added to the database in the future, each *Brassica* species will be reported as a separate dataset.

2.2. Rice

For rice, most varieties grown worldwide belong to the species *Oryza sativa*. Even though there are other species grown and cultivated, data and information are limited. *O. sativa* has two