Hort Innovation

Final Report

Nutritional analysis of across horticultural commodities

Project leader:

Associate Professor Lucinda Black

Delivery partner:

Curtin University

Project code:

ST19036

Project:

Nutritional analysis of across horticultural commodities (ST19036)

Disclaimer:

Funding statement:

This project has been funded by Hort Innovation, using multi-industry research and development levies and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Publishing details:

ISBN 978-0-7341-4840-7

Published and distributed by: Hort Innovation

Level 7
141 Walker Street
North Sydney NSW 2060

Telephone: (02) 8295 2300

www.horticulture.com.au

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Public summary

Australia has lacked up-to-date food composition data for many horticultural commodities. The majority of data that are reported in the Australian Food Composition Database for many fresh fruits and vegetables were generated up to 30 or more years ago. This project provides new nutrient composition data that represent current varieties and growing conditions for Australian edible horticultural commodities.

Australian grown horticultural commodities produced by levy paying horticultural industries were selected following consultation with Hort Innovation. Nutrient data gaps and data that were in need of update were identified in collaboration with Food Standards Australia New Zealand, the manager of the Australian Food Composition Database. A sampling plan was developed with the aim of purchasing commodities at the peak of their season. In order to capture the natural geographical variation in nutrient composition, 6-19 purchases per commodity were made across three cities (Sydney, Melbourne and Perth), resulting a total of 932 purchases. These food samples were analysed for relevant nutrients, including proximates, organic acids, vitamins, minerals, fatty acids and antioxidants at the National Measurement Institute of Australia.

The primary outputs of the project are profiles for ~150 nutrients across >90 Australian grown fruit, vegetable and nut commodities and, for relevant nutrients, the percentage of the Recommended Dietary Intake (%DI) of certain nutrients available from one serving of food. These outputs will allow

- Producers/levy payers and retailers to determine commodities as good sources of nutrients.
- Producers and manufacturers to make nutrition claims for commodities and products containing those commodities based on current analytical data.
- Producers and manufacturers to develop nutrition information panels and make nutrition claims for packaged produce and products based on current analytical data.
- Retailers to promote produce and products as good sources of relevant nutrients
- Consumers to identify and select good sources of key nutrients.
- Health educators and professionals to recommend appropriate foods for optimal health and develop appropriate public health nutrition messages.
- Researchers and health professionals to determine and optimise intakes of nutrients from horticultural commodities.
- Food regulatory bodies to monitor relevant nutrients in the food supply.

The new food composition data will be freely available through the Australian Food Composition Database. The %DI data will be incorporated into Hort Innovation's *The Good Mood Food* website.

Keywords

Australia; food composition; fruit; nuts; nutrient; vegetable.

Introduction

The Australian horticulture sector is a multi-billion dollar industry that provides employment Australia-wide, particularly in rural and regional areas [1]. The Australian agricultural industry, known for its stringent quality control standards, supplies the domestic and international markets with a wide range of high-quality produce and is projected to grow to a ~$85 billion farm-gate value by 2030 [2]. Among identified drivers of this growth is off-farm research and development, and market access and development [2].

Plant foods are naturally nutrient dense, which is a valuable attribute that can be highlighted in marketing. Furthermore, through inclusion of plant foods, multi-ingredient food products may be promoted for their nutritional benefits. To enable marketing and promotion of food products, accurate food composition data are needed to identify key nutrients. Food composition data can be used in a variety of promotional and value-adding ways to promote purchase and consumption of commodities throughout the value chain to the benefit of all industry stakeholders.

In 2020, nutrition claims were developed for Hort Innovation's horticultural sector marketing initiative, *The Good Mood Food* educational website [3] (Project ST19037). Plant foods were grouped by their potential to improve mood via their influence on the gut, brain, and nerves, and energy, stress and fatigue, based on the food's nutrient content. This message could be reinforced with the availability of up-to-date food composition data that represent the Australian-grown produce currently available.

The Australian Food Composition Database (AFCD) [4] provides food composition data for horticultural commodities. However, in many cases the data are outdated and/or based on limited sampling, and may no longer sufficiently represent the nutrient content of produce. Nutrient content may vary by geographical or climatic conditions, production method and by variety within commodities, factors which may change over time. The methods used to measure many nutrients have also improved over time, allowing more accurate reporting across a greater range of nutrients. Investment by the horticultural industry was key to generating current and representative food composition data for a wider range of horticultural commodities, as resources to support analytical programs to update food composition data are extremely limited outside the industry. This project aimed to update the national food composition data for edible Australian-grown horticultural commodities by using current analytical methods to measure the nutrient content of plant food samples that represent the current growing conditions in Australia. The specific objectives of the project were:

1. To develop a sampling plan in liaison with Food Standards Australia New Zealand (FSANZ) for updating the national food composition data for edible horticultural commodities in Australia.
2. To produce accurate, reliable and representative food composition data for edible horticultural commodities in Australia for inclusion in the AFCD.
3. To calculate the percentage of the daily intake for nutrients and energy that will be obtained from consuming one serving of the food.

The project provided outcomes that are of benefit to all stakeholders of the Australian horticultural industry. The new data generated will allow:

1. Levy payers and value chain members to identify, label and promote commodities as good sources of key nutrients.
2. Consumers to identify and select good food sources of key nutrients.
3. Health educators and professionals to recommend horticultural produce based on nutrient content.
4. Health educators and professionals to develop appropriate public health nutrition messages.
5. Researchers and health professionals to estimate and optimise intakes of nutrients from plant foods.
6. Food regulatory bodies to monitor relevant nutrients in the food supply.

The new food composition data will be freely available through future releases of the AFCD [4]. The %DI data will be incorporated into Hort Innovation's *The Good Mood Food* website [3]. The project has also provided nutrient composition data updates to other projects running concurrently to conduct scientific literature reviews for specific industry sectors, namely, the citrus, sweet potato, avocado, nut, mushroom, melon and onion industries.

Methodology

Sampling

The commodities of interest were identified in collaboration with Hort Innovation, following their consultation with levy payers. For each commodity, nutrient data gaps (where data were either missing or outdated) were identified through searches of the AFCD [4] and through discussions with FSANZ' Food Composition Team. A matrix of nutrients required per commodity was developed (Appendix 1).

A sampling schedule was developed with the aim of capturing the nutrient content of each commodity at its peak season; commodities were assigned to one of 12 sampling rounds that occurred between June 2021 and May 2022 (Appendix 2). In order to capture the variation that occurs due to geographic location and production practice, samples were collected for each commodity in three cities, Sydney, Melbourne and Perth. Primary samples were purchased by staff of the National Measurement Institute (NMI) according to specific purchasing guidelines (Appendix 3), and labeled with an NMI sample label detailing the commodity type, state of origin, state sample number (e.g. NSW purchase No. 4), and a unique NMI sample ID. The purchaser recorded relevant information for each sample, including the date of purchase, packaging format, store name and store location (Appendix 3). Samples were transported by courier to NMI's Port Melbourne laboratory for preparation and analysis. Samples were kept chilled from the point of purchase until preparation.

Sample preparation

Upon arrival at NMI, primary samples were photographed to capture: Appearance (i.e., colour, ripeness, variety, condition), original packaging or produce stickers (where applicable, capturing all details, including country of origin), and the NMI sample label (Appendix 4).

Samples were prepared (i.e., trimmed, peeled, de-seeded etc.) as they would be for consumption (Appendix 5). The components (e.g., flesh, skin, seeds) and weights of the edible and inedible portions were recorded. For some samples (chestnut, currant, prune, raisin, sultana, orange juice, sun muscat, green grape, red grape, olive, dried apricot), density (g/mL), measures were carried out by weighing a 250 mL cup (or part thereof) of product. For 40 samples, an aliquot of each primary sample was removed and immediately analysed individually for vitamin C, in order to prevent loss of vitamin C during further preparation. Equal aliquots of the remaining primary samples were then homogenized together to create a composite sample for each commodity. All samples were analysed raw only, with the exception of chestnuts, which were analysed cooked only, and mushrooms and eggplant. For mushrooms and eggplant, each primary purchase was halved to allow analysis of one raw and one cooked sample.

Cooked samples

Whole chestnuts with shell on were weighed and baked for 18 minutes at 200℃; chestnuts were turned halfway through cooking. Following cooking, weights were recorded before and after shelling.

Mushrooms allocated to the cooked sample were weighed and placed in a heated frying pan with no added oil or fat and cooked until they turned a light brown colour and appeared well-cooked. The weight of the cooked sample was recorded.

Eggplant allocated to the cooked sample were weighed, placed on baking paper and baked for 30 minutes at 180℃, at which point the flesh and skin appeared soft/collapsed. The weights of cooked edible and inedible (stem and any leaves) matter were recorded separately.

Analysis

All nutrients were measured at NMI's Port Melbourne laboratory, with the exception of the following: dietary fibre and starch (Australian Export Grains Innovation Centre [AEGIC], North Ryde), vitamin B5, (Bureau Veritas AssureQuality [BVAC], Melbourne until January 2022; NMI from February 2022), vitamin B7 (BVAC, Melbourne) and folate (PathWest, Perth). All laboratories involved in the analyses are accredited (ISO17025) by the National Association of Testing Authorities for analysis of the respective nutrients, except in the case of NMI and vitamin B5. Due to technical issues with vitamin B5 VitaFast test kits, analysis of this nutrient was discontinued at BVAC in January 2022. NMI took over these analyses in February 2022, using a quadrupole time-of-flight and quattro micro tandem mass spectrometry method that is based on earlier publications [5-7] and yielded similar results to those provided by the BVAC method. Summaries of other methods used are provided as Appendix 6.

Data handling and quality checks

Where necessary, raw analytical results were converted to the measurement units used in the AFCD [4]. Existing data from the AFCD were used, where available, to confirm that the new analytical data were within a reasonable range, taking into account expected differences due to natural variation and improvements in analytical methods. The national food composition databases of other countries (e.g., New Zealand [8] and the US [9]) were referred to when needed to confirm whether a result was reasonable. The sum of proximates (SOP), calculated as the sum of values for moisture, protein, fat, ash, dietary fibre, total sugar, starch and organic acids was deemed acceptable if within the range of 97-103 g/100 g.

If a result was deemed questionable, it was queried with NMI. Where the query remained unresolved, a re-test was requested. If a doubtful result was returned upon re-testing, re-sampling and re-testing was arranged.

Values for energy, total carbohydrate, beta-carotene equivalents, vitamin A equivalents, vitamin E equivalents, vitamin B3 derived from tryptophan and niacin equivalents were calculated using equations detailed in the AFCD [4]. Results for fatty acids were reported by NMI as a percentage of the total fatty acid content. Concentrations for fatty acids were calculated as: fat concentration x ((percentage fatty acid content/100)X 0.956) [10].

Where nutrients were not included for analysis in this project due to having existing up-to-date data in the AFCD, the existing data were used to complete the nutrient profile of a commodity using a dry matter adjustment as follows: (AFCD nutrient concentration/(100 – AFCD moisture concentration)) x (100 - moisture concentration of analysed food). Where appropriate, data for a nutrient in a similar commodity included in this project were used to complete the nutrient profile, e.g., the biotin content of green capsicum was estimated from the new analytical value for biotin in red capsicum using a dry matter adjustment.

Estimating the nutrient content of cooked foods

For commodities that may be consumed cooked, the nutrient content of the cooked version was estimated using nutrient profile of the raw commodity. Weight loss and retention factors [4] specific to the type of food and cooking method were applied to make estimations based on dry (e.g., baked, stir fried) and/or moist (e.g. boiled, steamed) heat cooking methods, as appropriate.

Recording of food details

The food details compiled for this project are metadata required for the AFCD and can be used to update information provided on *The Good Mood Food* website. A food details file was compiled for each commodity detailing sampling information, mass as purchased and per edible portion, edible and inedible fractions and materials. *The Good Mood Food* serve sizes (by weight and pieces per serve) [3] were displayed alongside calculations for pieces per serve based on new sample weight data. Where relevant, density (g/mL) and percentage weight loss due to cooking were recorded.

Calculation of percentage of daily intake recommendations

The percentage of the recommended daily intake (%DI) provided per serve of each commodity was calculated for relevant nutrients based on %DI reference values from the Australia New Zealand Food Standards Code (Standard 1.2.8 and Schedule 1) [11] and serve sizes published on *The Good Mood Food* website [3].

Results and discussion

A total of 932 primary samples were purchased and analysed as 349 individual samples for vitamin C and as 102 composite samples for other components. Nutrient profiles were developed across 148 food components, foods details were compiled and %DIs were calculated for 92 fruit, vegetable and nut commodities (Appendix 7).

Sampling

Despite the considerable impacts of the COVID-19 pandemic (on: the availability of produce; the ability of staff to purchase samples; transportation systems; laboratory staffing levels and analytical capacity), almost all commodities were sampled in reasonable quantities (6-19 separate purchases) and analysed as planned. For some commodities, this involved resampling and analysis in a later sampling round to supplement suboptimal sampling numbers in an earlier round. Where this occurred, the results of separate sampling rounds were combined using a weighted average, based on the number of sample purchases in each round. In the case of persimmon, a more limited sample was collected; however, it was still possible to purchase samples across all three cities (total purchases n = 6 (individual fruits n = 28); Sydney purchases n = 1 (individual fruits n = 5); Melbourne purchases n = 3 (individual fruits n = 12), Perth purchases n = 2 (individual fruits n = 11)).

Quality checks and analytical data

For the majority of samples, the SOP was within the acceptable range. For certain commodities with properties and composition known to complicate analysis, data published in the AFCD have been accompanied by notes to use the data with caution due to low SOPs. A number of such commodities analysed in this project had SOPs outside the acceptable range. For example, dried fruits can be difficult to homogenise due to their stickiness. While the SOP for prunes analysed in this project was low (93.7 g/100 g), it was possible to improve considerably on earlier analyses, with a greater proportion of proximate components accounted for compared to existing AFCD data (AFCD ID F007494 Prune (dried plum), SOP = 81.8 g/100 g). Nutritional analysis of nuts has also proved challenging in the past, possibly due to the presence of proximate components that are difficult to capture, or analytical complications due to relatively high fat content. Almonds analysed in this study had a similarly low SOP (95.9 g/100 g) compared to existing AFCD data (AFCD ID F006081, Nut, almond, with skin, raw, unsalted, SOP = 95.6 g/100 g). However, the SOP for pistachios analysed in this study was markedly lower (93.0 g/100 g) than existing AFCD (AFCD ID F006113, Nut, pistachio, raw, unsalted, SOP = 101.9 g/100 g). This was despite reanalysis of starch and fat components that were suspected as sources of uncertainty; therefore, we recommend that the data generated for pistachio in this study be used with caution. While the SOP for orange juice appears high, this is due to results for this liquid commodity being reported per 100 mL, rather than per 100 g; accounting for the density of orange juice, the SOP is within the acceptable range.

Analytical results were generally within reasonable ranges in comparison to existing data, accounting for natural variation and progress made in analytical methods. Any questionable results were resolved through queries, reanalysis and resampling and reanalysis, when deemed necessary. The advancement of analytical methods over the past few decades, and improved understanding of the behaviour and stability of compounds following extraction from the food matrix, has allowed more accurate representation of the composition of many nutrients in foods. Chromatography methods have progressed considerably to include more advanced detectors, while modern chromatographic columns allow improved separation of compounds and minimise co-elution. However, some limitations remain. There are limited comparator data available for polyphenols, flavonoids and anthocyanins data. The Phenol-Explorer database [12] contains data collected globally for individual polyphenols, flavonoids and anthocyanins in foods, but as the data provided for individual polyphenols, flavonoids and anthocyanins vary by food and do not necessarily represent the total content of these components, it is not possible to use them as comparator data for the total concentrations produced for these components in this project. This is an emerging area, and while the total polyphenol, flavonoid and anthocyanin data reported here represent a starting point for reporting of these antioxidant components in Australian foods, the data should be used with caution. We recommend that, as analytical methods for individual polyphenols, flavonoids and anthocyanins become more physically and financially accessible in Australia, that analysis of these components is revisited in those horticultural commodities that were found to have high total values in this project.

As is the case with all food composition data, the analytical data reported here may not represent the exact nutrient content of an individual food that is consumed due to various factors (e.g., natural geographic and seasonal variation, sampling and analytical uncertainties and limitations, variation in production practices). However, this project has considerably improved the representation of food composition data for a wide range of nutrients in Australian-grown horticultural commodities.

Food details

We found that the serve sizes by weight provided on *The Good Mood Food* website are generally reflective of the Australian Dietary Guidelines [13]. However, the interpretation of the serve size by weight into pieces per serve appears to reflect the weight of produce as purchased. This is problematic in terms of making nutrient claims for commodities with a considerable proportion of inedible material. In the case of mango as an example, we found that one fruit as purchased weighs ~250 g, which includes ~150 g of edible material. *The Good Mood Food* website states that one serve equals “150 g (1/2 mango raw)”. However, following removal of inedible material, one half of the average mango purchased for this project would yield only 75 g of edible material and, therefore, a whole fruit would need to be consumed to meet a serve of 150 g edible fruit. This greater serve size would also need to be used to make claims based on nutrient levels present in the edible portion. In our food details data sheet, we have provided values for mass per piece as purchased and mass per piece based on edible portion. Where these values differ considerably due to the presence of inedible material, we recommend that *The Good Mood Food* website be updated so that the number of pieces per serve weight is reflective of the number of pieces required to provide one serve weight of edible material. We have provided new ‘pieces per serve based on edible portion’ data to assist with this; these data, that are based on our up-to-date sample weight data, may also be used to update *The Good Mood Food* website for commodities with no inedible material where newly calculated ‘pieces per serve’ data differ to those based on older sample weight data.

%DI

In general, the %DIs calculated were as expected. There was, however, a discrepancy between the %DI previously calculated from existing AFCD data for vitamin E in orange-fleshed sweet potato (12%) and that calculated from our new data (0%). The 12% vitamin E DI value, which allowed orange-fleshed sweet potato to be claimed as a source of vitamin E, was based on an AFCD entry of 0.7 mg/100 g alpha tocopherol in AFCD ID F009035 Sweet potato, orange flesh, peeled, fresh, raw, which is stated as being borrowed from NZ FOODfiles 2014 ID X1055 Kumara, root vegetable, root tuber, flesh, raw, Orange, Beauregard. In contrast, our new analysis found no quantifiable concentration (limit of reporting (LOR) = 0.1 mg/100 g) of alpha tocopherol in orange-fleshed sweet potato samples purchased in August 2021. Upon investigation, it was found that the original NZ Food files entry for alpha tocopherol in ID X1055 was 0.07 mg/100 g and had been incorrectly transcribed into the AFCD. Resampling and reanalysis of tocopherols in orange-fleshed sweet potato in May 2022 confirmed our August 2021 <LOR result; therefore, it should be noted that orange-fleshed sweet potato should no longer be claimed as being a source of vitamin E by producers, or on *The Good Mood Food* website.

For foods not included on *The Good Mood Food* website, serve sizes were assumed to be the same as a similar included food (i.e., Brussels sprout based on cabbage, lettuce based on baby spinach, parsnip based on carrot, snow pea based on green pea, purple sweet potato based on orange sweet potato) or estimated (i.e., chilli serve size estimated as the edible portion one half of a long red chilli).

Photos/images/other audio-visual material

Photographs of samples are provided as Appendix 4.

Outputs

Table 1. Output summary

Output	Description	Detail
Sampling plan developed in collaboration with FSANZ and Hort Innovation	The sampling plan detailed the 92 commodities that would be purchased in each of 12 sampling rounds conducted between June 2021 and May 2022, and the nutrients that would be analysed. The data were intended for use by Hort Innovation, NMI and readers of this report.	The sampling plan was provided to Hort Innovation as Milestone 102 and was used to ensure timely purchase and analysis of commodities of interest during their peak season (Appendices 1 and 2).
Analytical food composition database	The food composition database provides a nutrient profile for 92 fruit, vegetable and nut commodities. The data are intended for use by all horticultural industry stakeholders, including the general public.	The partial database was provided to Hort Innovation as Milestone 103. The full database is made available with this final report (Appendix 7). The full database will also be provided to FSANZ for inclusion in the next release of the AFCD. This will make the data freely available online for use of all horticultural industry stakeholders, including the general public. Further dissemination is planned: a manuscript is under preparation for submission to a peer-reviewed journal and an abstract will be submitted to an academic conference.
%DIs	%DIs are provided for 92 fruit, vegetable and nut commodities. The data are intended for use by all horticultural industry stakeholders, including the general public.	A partial %DIs file was provided to Hort Innovation as Milestone 104. The full set of %DIs is made available with this final report (Appendix 7). This will allow incorporation of this data into *The Good Mood Food* website by Hort Innovation, making the data freely available online for use of all horticultural industry stakeholders, including the general public.

Please find attached the following output files:

"ST19036 Appendix 1_Nutrients by Sample"

"ST19036 Appendix 2_Sampling Schedule"

"ST19036 Appendix 7_ Nutrient composition"

Extension activities:

Table 2. Extension activities

Project	Information provided from project ST19036
CT20004 - Citrus nutrition literature review (Teri Lichtenstein, FoodBytes)	Data on citrus fruits
PW20001 – A review of the scientific literature on the health and nutrition of sweet potato – Professional Nutrition Services Nicole Senior	Data on sweet potato (orange-, white- and purple-fleshed varieties)
AV20003 – Educating health professionals on the Health and Nutritional benefits of Avocados – Bite Communications Andrea Brydges	Data on avocados (Hass and Shepard varieties):
HN19000 Nuts for Life – Educating Health Professionals – Australian Nut Industry Council	Data on nuts
MU20003 – Educating the food industry about Australian Mushrooms – Australian Mushroom Growers Association Ltd – Martine Poulain	Data on mushrooms
VM20003 – Educating health professionals about Melon nutrition- Nutrition Research Australia – Flavia Fayet-Moore	Data on melons
VN20002 – Onion nutrition education program for health professionals and the food industry service- Bite Communications- Andrea Brydges	Data on onions

Outcomes

Table 3. Outcome summary

Outcome	Alignment to fund outcome, strategy and KPI	Description	Evidence
New data included in the AFCD	Support product differentiation and initiate stakeholder education initiatives (e.g., health benefits)	Analytical data and food details data will be provided to FSANZ for incorporation into the AFCD. These data themselves allow differentiation between commodities and underpin other data derived from (e.g., %DIs, nutrition information panels) and based on (e.g., education initiatives to promote health benefits) them that can be used by Fund stakeholders to promote produce.	Appendix 7: "ST19036 Appendix 7_ Nutrient composition" Partial data were provided to Hort Innovation with Milestone 103 and 104, with feedback received that the data and their formatting were in line with expectations. FSANZ have been consulted throughout the process to ensure that the data provided are of sufficient quality, complete and fit for inclusion in the AFCD.
New data used by other projects for literature reviews on specific commodities	Support product differentiation and initiate stakeholder education initiatives (e.g., health benefits)	Analytical data, food details data and %DI data have been provided to inform seven other projects that aim to conduct scientific literature reviews and develop education resources for health professionals and food industry stakeholders for specific Funds.	Emails carrying the transferred data to the relevant project teams were carbon copied to Hort Innovation Meetings have been conducted with leaders of these other projects to ensure that the data are understandable and fit for use. Feedback has been sought from leaders of these other projects and queries have been resolved. Feedback to date has indicated that the data were fit for purpose.
Commodities identified as key sources of specific nutrients	Support product differentiation and initiate stakeholder education initiatives (e.g., health benefits)	%DI data identify individual commodities as key sources of specific nutrients and support product differentiation. These data have already been incorporated into extension activities outlined in the previous section and may be used by Hort Innovation and all stakeholders in future	Appendix 7: "ST19036 Appendix 7_ Nutrient composition" Partial data were provided to Hort Innovation with Milestone 104, with feedback received that the data and their formatting were in line with expectations.

		education initiatives.	
Increased product differentiation	Support product differentiation and initiate stakeholder education initiatives (e.g., health benefits) Target high-value customers with product differentiation through best practice market intelligence, improved branding and an increased focus on value-adding	%DI data identify individual commodities as key sources of specific nutrients and support product differentiation. These data have already been incorporated into extension activities outlined in the previous section and may be used by Hort Innovation and all stakeholders in future education initiatives and to target customers.	Appendix 7: "ST19036 Appendix 7_ Nutrient composition" Partial data were provided to Hort Innovation with Milestone 104, with feedback received that the data and their formatting were in line with expectations.
Increased consumer knowledge	Support product differentiation and initiate stakeholder education initiatives (e.g., health benefits)	Analytical data and %DI data can in turn be used to increase consumer knowledge of the health benefits of consuming vegetable, fruit and nut commodities via education resources/programs, product advertising/packaging, nutrient claims and nutrition information panels. The data have been provided to inform seven other projects that aim to conduct scientific literature reviews and develop education resources for health professionals and food industry stakeholders for specific Funds. The outputs developed by those other projects can in turn be used to increase consumer knowledge of the health benefits of consuming vegetable, fruit and nut commodities.	Appendix 7: "ST19036 Appendix 7_ Nutrient composition" Partial data were provided to Hort Innovation with Milestone 103 and 104, with feedback received that the data and their formatting were in line with expectations.
More accurate nutrition information panels, nutrition claims, public health nutrition messages	Support product differentiation and initiate stakeholder education initiatives (e.g., health benefits)	Analytical data and %DI data can be used to produce nutrition information panels and to inform nutrition claims and public health nutrition messages.	Appendix 7: "ST19036 Appendix 7_ Nutrient composition" Partial data were provided to Hort Innovation with Milestone 103 and 104, with feedback received that the data and their formatting were in line with expectations.

Monitoring and evaluation

Table 4. Key Evaluation Questions

Key Evaluation Question	Project performance	Continuous improvement opportunities
To what extent has the project achieved its expected outcomes?	The project has improved the breadth and accuracy of data on nutritional composition of Australian horticultural commodities through a comprehensive sampling (developed in collaboration with Hort Innovation and FSANZ) and use of up-to-date analytical methods across a wide range of relevant nutrients. The data have improved knowledge on nutritional composition across >90 commodities across multiple industries	Continued levy funding could be made available to allow maintenance of up-to-date and relevant food composition data. Data could be reviewed and updated as production practices change, new varieties are introduced and analytical methods progress.
How relevant was the project to the needs of intended beneficiaries?	The sampling plan and analysis plan met the needs of levy payers by addressing data gaps in existing food composition data The sampling plan addressed all gaps in knowledge in nutritional composition of the commodities tested to the best possible extent within resourcing constraints and accessibility (physical and financial) to analytical methods. The project has provided substantially improved, more accurate and updated data sets for the AFCD.	As further funding and accessibility to analytical methods allow, more comprehensive analytical data for nutrients such as individual polyphenols, flavonoids and anthocyanins could be produced.
How well have intended beneficiaries been engaged in the project?	The project has satisfied the objective of the project by providing the most accurate and up to date data on the included commodities in consultation with Hort Innovation (representing all industries which require more up-to-date data) and the AFCD. Regular project updates been provided through linkage with relevant industry communication projects.	
What efforts did the project make to improve efficiency?	The project team worked effectively to improve and maintain efficiency throughout the project with minimal delays, despite the	Levy funding should continue to be used to support industry communication projects to inform the industries and their stakeholders

	notable impacts of the COVID-19 pandemic. The project team has maintained contact with the teams from other related projects and kept them informed as to when data would become available. Project ST19036 supplied data to all other related projects and respective nutritional education projects to amplify the dissemination of information.	of the new data generated through this project.
What efforts did the project make to maximise output quality?	Data were verified and benchmarked against national and international external sources wherever possible.	As comparator data on total polyphenols, flavonoids and anthocyanins become more available globally and locally, those new data could be verified.

Recommendations

- Producers and food manufacturers could access and use the data generated by this project to promote key nutrients, e.g., through *The Good Mood Food* website, advertising or packaging.
- Continued levy funding for food composition data:
  - Nutrient composition data could be updated as new varieties are added to the market
  - Nutrient composition data could be updated if production practices change
  - Nutrient composition data could be updated as analytical methods progress
  - The polyphenol content of commodities could be more comprehensively explored in a dedicated project
  - Due to the impacts of COVID-19 on the ability to purchase samples, and availability of produce, only six persimmon samples were included in this project. Further sampling of this commodity at a later date could provide a more representative nutrient profile.
- Update *The Good Mood Food* website as follows:
  - Update 'pieces per serve' based on 'pieces per serve based on edible portion' data provided in the Food Details File (Appendix 7)
  - Remove vitamin E from the list of nutrients in sweet potato (in both orange and white sweet potato varieties) that boost mood and update the nutrition information panels shown for each sweet potato variety

Refereed scientific publications

Journal article (manuscript in preparation)

Dunlop, E., Cunningham, J., Adorno, P., Johnson, S., Black, L.J., Nutrient composition of Australian-grown horticultural commodities.

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Intellectual property

No project IP or commercialisation to report

Acknowledgements

We gratefully acknowledge the contribution of Dr Stuart Johnson, who was Project Manager from April 2021 until February 2022, and the assistance provided by FSANZ' Food Composition Team.