



**An Roinn Talmhaíochta,  
Bia agus Mara**  
Department of Agriculture,  
Food and the Marine

**Food Institutional Research Measure**

**Final Report**

Development of online dietary assessment tool

**DAFM Project Reference No:** 13/F/424  
**Start date:** 01/12/2013  
**End Date:** 31/11/2016

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University College Cork. Dr. Claire Timon, University College Dublin

Please place one "x" below in the appropriate area on the research continuum where you feel this project fits

Basic/Fundamental		Applied		Pre Commercial		
1	2	3	4	5 X	6	7

Please specify priority area(s) of research this project relates to from the National Prioritisation Research Exercise\* (NRPE) report;

<b>Priority Area (s)</b>	<b>Food for Health, Digital Platforms, Content &amp; Applications, Connected Health and Independent Living</b>
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**Key words:** (max 4) web based dietary assessment, 24 hour dietary recall, Foodbook24, nutrition surveillance

## **1. Rationale for Undertaking the Research**

The improvement of existing databases to underpin public health policy is required to ensure 'effective involvement with other EU countries for exploration of links between food and health within the European Research Area and/or Joint Programme Initiative (JPI) on Healthy Diet for a Healthy Life (HDHL)'. This research addresses these needs, developing an online dietary assessment tool for use in future national food consumption surveys. Development of this tool will build on and improve the existing strategy for dietary assessment, using innovative and cutting edge online approaches.

To date a suite of Irish national food consumption surveys have been completed, internationally recognised for their excellence and quality of data ([www.iuna.net](http://www.iuna.net)). Such surveys used the semi-weighed-intake method, collecting detailed dietary information as well as brand, packaging and eating location. Future surveys must continue to collect this information, but must meet the needs of the European Food Safety Authority (EFSA), who have issued general principles to guide the collection of 'dietary information that can be used to estimate nutrient intake and to assess exposure to biological agents and chemical substances' in which it clearly states that 'It is recommended that surveys cover two non-consecutive days and use the dietary record method for infants and children and the 24-hour recall method for adults. It is further recommended to use a food propensity/frequency questionnaire and that supplementary information, in particular on brand name, physical characteristics of the packaging, cooking procedures and other specific information, such as fortification should be collected' (EFSA, 2009). Within these guidelines, they specifically call for 'initiatives to further develop web-based tools in the area of dietary surveys'.

The development of this tool ensured that dietary intake collection in Ireland meets the needs of EFSA and aligns such datasets for inclusion with the JPI HDHL. Foodbook24 will also facilitate state of the art, cost effective collection of dietary intake data, allowing larger cohorts to be targeted the collection of rolling (repeated) data, giving the opportunity of examination of dietary change over time.

## **2. Research Approach**

The development of Foodbook24 involved 3 phases. Phase 1 used qualitative methods (surveys and interviews) to investigate the acceptability of the proposed tool. Respondents representing stakeholder organisations/institutions in Ireland took part in a survey to evaluate the proposal of a web based dietary assessment tool. Results highlighted that the majority of respondents were in favour of the development of a web based dietary assessment method and stated they would use this type of tool in their respective organisation/institution. A comprehensive review of the literature on web based dietary assessment methodologies (see publications listed below) and the findings from the stakeholder shaped the proposed design of the tool. The design of the tool follows the previously published multi-pass 24 hour recall model, with in built linked foods and prompt questions to ensure complete capture of food intake data. The tool also collects information on supplement use, occasionally consumed foods and eating behaviours. Phase 2 involved the development of 3 comprehensive information databases (food and beverage list, nutritional

composition data and portion size data) to populate the content of the Foodbook24 tool. This resulted in the compilation of a dataset of 926 food and beverage items (derived from the Irish National Adult Nutrition Survey) with prompt questions proposed for 123 food and beverage items and linked food/beverage options for 255 foods. Phase 3 involved the physical development of the software by Creme Global. The development process involved fortnightly meetings with the Foodbook24 team and software developers from Creme Global. On completion of Phase 3, the Foodbook24 tool was in comparative and validation studies to assess the acceptability and validity of the tool.

The validity and acceptability of Foodbook24 was rigorously assessed in two separate studies over the course of the project. The first study involved the recruitment of 81 participants who recorded dietary intake using a traditional interviewer led approach and the Foodbook24 tool. The results of this investigation indicated both methods were comparable with regards to the recording of dietary intake. These results, alongside the reduced cost and participant burden associated with Foodbook24, highlight the tool's potential as a viable alternative to the interviewer-led 24 hour dietary recall (24HDR). Validity of the 24HDR component was assessed by 40 participants, who completed 3 nonconsecutive, self-administered 24HDR using Foodbook24 and a 4-day semi-weighed food diary at separate time points. Participants also provided fasted blood samples and 24-hour urine collections for the identification of biomarkers of nutrient and food group intake during each recording period. The results of this investigation further supported the validity of the tool. Across both studies, a total of 118 participants evaluated the acceptability of Foodbook24. The tool was well-received and the majority, 67.8% (80/118), opted for Foodbook24 as the preferred method for future dietary intake assessment when compared against a traditional interviewer led recall and semi-weighed food diary.

The potential of Foodbook24 as an alternative approach to nutrition surveillance in Ireland was also investigated during this project. The Proof of Principle (PoP) study, whereby the Foodbook24 was made publically available for use by the Irish adult (aged 18 years and over) population took place between March 2016 and October 2016. A total of 1661 participants registered to take part in the PoP study with a personal email and password at [www.foodbook24.com](http://www.foodbook24.com). Of this initial figure, 1095 participants provided demographic information, 919 participants completed 1 dietary recall, 632 completed 2 dietary recalls and 572 participants completed all dietary components of the tool (2 dietary recalls, a food frequency questionnaire and a food choice questionnaire). Participant characteristics and dietary intakes observed as part of the National Adult Nutrition Survey (2008-2010) were compared to data collected during the short PoP study with Foodbook24. The results indicate that similar dietary intakes were observed in both studies (although under reporting and inaccuracies due to self-reported weight remain to be investigated). The characteristics of participants involved in the PoP were overall comparable to those participants that completed the NANS. A publication detailing the overall results of this investigation is currently in preparation and this was presented at the 21<sup>st</sup> International Congress of Nutrition in October 2017.

### **3. Research Achievements/Results**

- The Foodbook24 tool was developed during this project. Foodbook24 is a web based dietary assessment tool based on the 24 hour multiple pass recall model and consists of additional

features such as demographic, food frequency and food choice questionnaires. Foodbook24 is the first web based dietary assessment method to be developed in Ireland (specifically developed using Irish food consumption data) and offers a potential cost effective approach to nutrition surveillance in Ireland.

- Foodbook24 was investigated in numerous studies during this project. The results from the comparison and validation studies suggests the tool performs well when compared to a interviewer administered 24 hour recall and a 4 day estimated food diary. The use of biomarkers of nutrient intake from blood and urine samples as an independent indicator of validity further confirmed the validity of Foodbook24.
- Participant acceptability data suggests Foodbook24 was well received by the majority of participants in this study sample which indicates the potential of Foodbook24 for use in nutrition related research or as a means of intermittent data collection between national nutrition surveys in Ireland.

#### **4. Impact of the Research**

##### ***The scientific community***

This research builds on and further develops existing collaborations in the areas of the food and health sciences that strengthens Ireland's capability in this area and maintains Ireland's position at the forefront of research on advances in dietary assessment in the EU. Foodbook24, as a validated dietary assessment tool offers an alternative to traditional approaches to dietary assessment for research purposes. This method offers a standardised data collection approach and a cost effective method for the collection and analysis of dietary intake data.

##### ***Industry***

To date, Foodbook24 has been used to collect dietary intake data from over 1000 Irish adults. Comparing this data to the previous National Adult Nutrition Survey (IUNA, 2011) highlighted changes in food trends which is important data for industry. The collection of rolling dietary intake data from specific cohorts would provide valuable insight for the Irish food industry for the purposes of product development and reformulation. Data collected using Foodbook24 could be used as an evidence base to support their nutrition and health orientated marketing.

##### ***Consumers***

Overall, Foodbook24 was well received by consumers and the majority preferred the tool compared to traditional pen and paper dietary assessment methods. This method also facilitates the remote collection of dietary intake data, reducing the burden associated with traditional dietary assessment. It has also been suggested in the literature that the remote collection of dietary intake may also alleviate some of the bias associated with the presence of a dietitian or researcher, yielding more honest reporting of dietary intake data. The potential to provide personalised dietary feedback is also an important service for consumers, highlighting areas of their diet that need to be addressed.

##### ***Regulatory authorities and policymakers***

The ability to collect food and nutrition data at a national level and to collect rolling data between large national surveys is an important resource for regulatory authorities and policymakers to ensure that policy development for food safety and nutrition at national and EU level is strongly evidence-based and protective of public health and reflects national needs to assess food trends and effectiveness of health promotion initiatives.

#### **4(a) Summary of Research Outcomes**

##### **(i) Collaborative links developed during this research**

UCD/UCC and Creme Global

UCD and MedEx Wellness in DCU

##### **(ii) Outcomes where new products, technologies and processes were developed and/or adopted**

- The Foodbook24 tool was developed during this project. Foodbook24 is a web based dietary assessment tool based on the 24 hour multiple pass recall model and consists of additional features such as demographic, food frequency and food choice questionnaires. Foodbook24 is the first web based dietary assessment method to be developed in Ireland (specifically developed using Irish food consumption data) and offers a potential cost-effective approach to nutrition surveillance in Ireland.
- A semi-automated process for the provision of food group based personalised dietary feedback was also established during this project. A detailed Standard Operating Procedure (SOP) was compiled describing the data analysis procedure required for the generation of this type of feedback. Over 500 of these reports were issued to participants during the course of the research project.
- Updated database of food portion size photographs, building on an existing food portion size photographic dataset developed within UCD for the FP7 Food4me project.

##### **(iii) Outcomes with economic potential**

The following commercial opportunities were identified based on qualitative research with healthcare professionals and nutrition service providers and review of the literature relating to dietary assessment and personalised nutrition:

###### ***a. Dietary assessment tool***

Further development of Foodbook24 would enable the licensing of a standalone dietary assessment tool to researchers, healthcare professionals or any organization interested in collecting dietary intake information.

###### ***b. Business to Business opportunity for existing Employee/Workplace Health and Wellness programmes/ services***

This is a business model in the business to business (B2B) context, offering health, lifestyle and wellbeing advice programme to employees. Its key value proposition focuses on a shared responsibility between the employee and its employer for a healthy lifestyle relevant to employee well-being and productivity. The key activity is feedback of lifestyle plan based on individual information and diagnostic data to employees. The 24 hour dietary recall or FFQ component of Foodbook24 could be integrated into existing employee health and wellness programmes and personalised dietary feedback for employees could be an additional benefit of these types of services.

#### **(iv) Outcomes with national/ policy/social/environmental potential**

There is potential for Foodbook24 to assist in the collection of national food and nutrient intake data for nutrition surveillance purposes. This potential is currently being investigated as part of an Industry fellowship which was awarded to Dr Claire Timon by SFI. The collection of rolling data intermittently between larger surveys could be used to inform and assess the effectiveness of health promotion initiatives.

#### **4 (b) Summary of Research Outputs**

(i) Peer-reviewed publications, International Journal/Book chapters.

- Timon C.M., Blain R.J, Evans E., Walton J., Flynn A., Gibney E.R. (2018) Investigating the potential of a self-administered dietary assessment tool to collect nationally representative dietary intake data. Foodbook24, a Proof of Principle Study. (submitted to *Advances in Nutrition*)
- Evans K., Hennessy Á, Walton J., Timon C.M., Gibney E.R. and Flynn A. (2017) Development and evaluation of a short food list for use in a web-based 24-hour dietary recall tool. *In press. Journal of Nutritional Sciences*
- Timon C.M., Blain R.J, Mc Nulty B, Kehoe L, Evans E., Walton J., Flynn A., Gibney E.R. (2017) The Development, Validation, and User Evaluation of Foodbook24: A Web-Based Dietary Assessment Tool Developed for the Irish Adult Population. *Journal of medical Internet Research*; 19(5)e158
- Timon C.M., Evans E., Blain R.J, Kehoe L, Walton J., Flynn A., Gibney E.R. (2017 )The comparison of nutrient intakes from a web-based 24 hour recall tool (Foodbook24) to an interviewer led 24 hour recall. *Nutrients* 25;9(5). pii: E425
- Timon C.M., van den Barg R, Blain R.J, Kehoe L, Evans E., Walton J., Flynn A., Gibney E.R. A review of the design and validation of web and computer based 24 hour dietary recall tools. *Nutr Res Rev*;29(2):268-280

(ii) Popular non-scientific publications and abstracts including those presented at conferences

- Timon C.M., Blain R.J., Pigat S., Bompola F., Walton J., Flynn A., and Gibney E.R. The potential of Foodbook24 to collect nationally representative nutrient intake data. 21<sup>st</sup> International Congress of Nutrition, October 2017
- Timon C.M., O' Donoghue S, Blain R.J, Kehoe L, Evans E., Walton J., Flynn A., Gibney E.R. The comparison of nutrient intakes from a web-based 24 hour recall tool (Foodbook24) to an interviewer led 24 hour recall. Proceedings of the Nutrition Society (2016), 75 (OCE3), E198
- Blain R.J, Timon C.M., Kehoe L, Evans E., Walton J., Flynn A., Gibney E.R. Acceptability of a web-based dietary assessment tool for an Irish adult population: Foodbook24. Proceedings of the Nutrition Society (2016), 75 (OCE3), E138
- Timon C.M., Blain R.J, Kehoe L, Evans E., Walton J., Flynn A., Gibney E.R. The validation of a web-based dietary assessment tool for an Irish adult population: Foodbook24. Proceedings of the Nutrition Society (2016), 75 (OCE3), E218
- Timon C.M., Ahern K., Walton J., Evans K., Flynn A., and Gibney E.R. An examination of the delivery of dietary feedback from web based dietary assessment tools. Ann Nutr Metab 2015; 67(suppl 1) page 249 FENS conference Nov 2015 Berlin
- Evans K., Hennessy Á., Walton J., Timon C.M., Gibney E.R., and Flynn A. Development of a short food list for use in a web-based dietary assessment tool. Ann Nutr Metab 2015; 67 (suppl 1) page 3 FENS conference Nov 2015 Berlin
- Timon C.M. Evans K., Walton J., Flynn A., and Gibney E.R. The development of an innovative web based dietary assessment tool for an Irish adult population: The Diet Ireland tool. Proceedings of the Nutrition Society (2015),74 (OCE4)E274 Nutrition Society Summer meeting 2015

(iii) National Report

N/A

(iv) Workshops/seminars at which results were presented

- Dr Eileen Gibney, Wageningen Seminar Series, Personalised Nutrition talk
- Dr Eileen Gibney, Food Matters Live, DietIreland and Personalised Nutrition
- Dr Claire Timon, Safefood Health and Technology, Discussion on technology and health assessment
- Dr Eileen Gibney, BDA Live Conference, Personalised Nutrition talk
- Dr Eileen Gibney, NuGo Short Course, Personalised Nutrition talk

(v) Intellectual Property applications/licences/patents

- Foodbook24 tool patent with UCD Nova

(vi) Other

1. Nutra Ingredients: Foodbook24 could aid nutrition surveillance in Ireland
2. Taste.ie: What are You Eating? Foodbook24 Tool Gives You Feedback from Ireland's Nutrition Experts
3. Irish Times: Want feedback about what you eat? Log your diet online

## 5. Scientists trained by Project

Total Number of PhD theses: 0

Total Number of Masters theses: 0

## 6. Permanent Researchers

Institution Name	Number of Permanent staff contributing to project	Total Time contribution (person years)
UCD	1	0.45 years
UCC	1	0.065 years
<b>Total</b>	<b>2</b>	<b>0.515 years</b>

## 7. Researchers Funded by DAFM

Type of Researcher	Number	Total Time contribution (person years)
Post Doctorates/Contract Researchers	1	2.74 years
PhD students		
Masters students		
Temporary researchers	2	3.41 years
Other		
<b>Total</b>	<b>3</b>	<b>6.15 years</b>

## 8. Involvement in Agri Food Graduate Development Programme

Name of Postgraduate / contract researcher	Names and Dates of modules attended
n/a	

## 9. Project Expenditure

Total expenditure of the project: € **369,639.61**

Total Award by DAFM: € **397,024.00**

Other sources of funding including benefit in kind and/or cash contribution(specify): €0

### Breakdown of Total Expenditure

Category	UCD Institution 1	UCC Institution 2	Total
Contract staff			
Temporary staff	50,755.20	52,841.80	103,597.0
Post doctorates	120,678.64		120,678.64
Postgraduates			
Consumables	3,678.80	528.0	4206.80
Travel and subsistence	3,649.25	4,245.0	7,894.25
<b>Sub total</b>	<b>178,761.89</b>	<b>57,614.80</b>	<b>236,376.69</b>
Durable equipment	1,544.95	806.0	2350.95
Other	59,999.40		59,999.40

(Subcontracting,  
software  
development)

Overheads                                      53,628.57                                      17,284.0                                      70912.57

<b>Total</b>	<b>293,934.81</b>	<b>75,704.8</b>	<b>369,639.61</b>
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## 10. Leveraging

Dr Claire Timon was awarded an SFI Industry Research Fellowship in January 2017 to further explore the commercial potential of Foodbook24 by developing the personalised dietary feedback component of the tool. This proposed work mainly focuses on the development of decision trees and databases to assess compliance with food group based dietary guidelines.

Bruna Mota (Brazil Study Abroad Student) worked on the project and other related research in Prof Gibney group for 6 weeks. During her placement in the Institute of Food and Health UCD, this student worked on the Foodbook24 project (a web based 24-hour dietary recall tool developed for the adult population). Bruna worked alongside the Foodbook24 research team to help with the compilation of dietary feedback reports for all of the volunteers that have used Foodbook24.

## 11. Future Strategies

The tool and expertise developed within this project will be utilised in both public health and future research projects. It is envisioned that the developed tool will be proposed for use as part of a nutritional surveillance strategy for Ireland, allowing longitudinal and ongoing estimates of population nutritional intakes. Use of this tool gives the potential for any data collected to be shared for pan European nutrient intake assessment. In addition the tool will be utilised in future national, European and international research collaborations.

## References

European Food Safety Authority. General principles for the collection of national food consumption data in the view of a pan-European dietary survey. EFSA Journal. 2009 Dec 18;7(12):1435.

Irish Universities Nutrition Alliance. 2011. National adult nutrition survey: summary report <http://www.iuna.net/>