Project number: 5713
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Bio-actives from by-products of food processing



Key external stakeholders:

Vegetable processors, government authorities/legislators, consumers, national food research institutes.

Practical implications for stakeholders:

Large volumes of waste are produced as a result of processing of foods. This project highlighted the potential of this waste as a source of bio-active compounds for inclusion in functional foods.

Main results:

- Fruit and vegetable by-product and waste sources in Ireland were tested for their antioxidant activity and polyphenol content. The highest levels of antioxidants measured by both ferric reducing antioxidant power (FRAP) and diphenyl-picrylhydrazyl (DPPH) assays were detected in whole kiwifruit. Of the vegetable by- products, broccoli stems showed the best antioxidant potential.
- A pressurized liquid method for the extraction of antioxidants from apple pomace utilizing 60% ethanol at temperature of 102°C was developed.
- A solid liquid extraction method for recovering antioxidant from apple pomace was also developed utilizing 56% ethanol, 80 °C and 31 min.
- Chitin extraction optimization using different organic acids, time and temperatures was evaluated. The optimal conditions for chitin extraction were 2M concentration, 2h steeping time 24ºC temperature which resulted in 98.86% and 90.28% purity for citric acid and lactic acid, respectively, at the ratio of 1:10.
- Optimal conditions of 75% ethanol, 80ºC and 22 min for the extraction of antioxidants from potato peel were determined using solid-liquid extraction. The use of pressurized liquid extraction did not enhance the extraction of antioxidants from potato peel.

Opportunity / Benefit:

The potential of high volume fruit, vegetable and fish processing waste as a source of bioactive compounds has been highlighted. A number of methods for the recovery of bio-active compounds using food friendly solvents have been developed. The methodologies developed could be used as a basis for up-scaled methods to recover bio-active compounds from food waste for inclusion in functional foods.

Collaborating Institutions:

DIT, NUIG, TCD, Natures Best Ltd, Keeling Fruit Importers

Contact Nigel Brunton Email: nigel.brunton@teagasc.ie

Teagasc project team: Dr. Nigel Brunton
Dr. Hilde Wijngaard

External collaborators: Dublin Institute of Technology
NUI Galway
Trinity College Dublin
Keeling Fruit Importers
Nature's Best Ltd.

1. Project background:

The objective of the project was to examine the potential of fish, fruit and vegetable waste/by-products produced during processing in Ireland as sources of antioxidant and other bio-active compounds for use in functional foods. Fish, fruits and vegetable processing in Ireland generates substantial quantities of waste/by-products but could serve as rich sources of bio-active compounds. Despite this very few bioactive ingredients have been developed from agri-industrial by-products. A variety of food waste/by-products was screened for their antioxidant potential. Enzyme and solvent assisted extraction of antioxidant compounds examined to optimize extraction of bio-active compounds from waste/by-products exhibiting high antioxidant capacities at the initial screening. The project involved the screening, isolation and characterization of bio-active compounds followed by analysis of their quality, sensory and nutritional properties in different food matrices. This project attempts to address gaps in our knowledge with regard to the potential use of waste/by-products/by-products produced as a result of processing by Irish food processors as a source of functional antioxidant compounds.

2. Questions addressed by the project:

Could waste/by-products, produced as a result of processing by Irish food processors, be used as a source of functional antioxidant compounds?

3. The experimental studies:

A number of assays already in use at the AFRC, NUI Galway, DIT and TC were adapted and validated for use in assessing the overall bio-activity of a variety of fish, fruit and vegetable waste/by-products. All samples were measured for total antioxidant activity using the 2,2-diphenyl-1-picryl hydrazyl and ferric reducing antioxidant power assays. The in vivo and in-vitro antihypertensive, anti-thrombotic, anti-inflammatory, anti-diabetic, anti-antioxidant and probiotic properties of the extracts was also be investigated. Depending on the sample type further screening involved assessing levels of antioxidant groups i.e., phenols, carotenoids and anthocyanins. Waste/by-products/by –products exhibiting high bio-activities at the initial were further characterised with regard to levels of key individual bio-active compounds by high performance liquid chromatography. Optimised extraction protocols of key antioxidant compounds were developed using a combination of solvent and enzyme assisted extraction. Concentrated extracts of the bio-active compounds were incorporated into a number of different food matrices.

4. Main results:

- Fruit and vegetable by-product and waste sources in Ireland were tested for their antioxidant activity and polyphenol content. The highest levels of antioxidants measured by both ferric reducing antioxidant power (FRAP) and diphenyl-picrylhydrazyl (DPPH) assays, were detected in whole kiwifruit. Of the vegetable by- products, broccoli stems showed the best antioxidant potential.
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5. Opportunity/Benefit:
Up-scaling of the optimised protocol for extraction of antioxidants and other bio-actives could allow fruit, vegetable and fish processors to utilize a valuable source of bio-active compounds for use in functional foods. Response surface methodology is a helpful method to assist in identifying optimal conditions, if some conditions (such as temperature) may be restricted.

6. Dissemination:, Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland

Main publications:
Wijngaard, H., & Brunton, N. (2009). The Optimization of Extraction of Antioxidants from Apple Pomace by Pressurized Liquids. Journal of Agricultural and Food Chemistry, 57(22), 10625-10631.

Wijngaard, H. H., Rößle, C., & Brunton, N. (2009). A survey of Irish fruit and vegetable waste and by-products as a source of polyphenolic antioxidants. Food Chemistry, 116(1), 202-207.

Wijngaard, H. H., & Brunton, N. (2010). The optimisation of solid-liquid extraction of antioxidants from apple pomace by response surface methodology. Journal of Food Engineering, 96(1), 134-140.

Popular publications:
Optimisation of Extraction of Antioxidant Compounds from Apple Pomace. Hilde Wijngaard and Nigel Brunton. Oral presentation by H. Wijngaard. 22nd to 24th April, 2009, Total Food 2009, Norwich, UK.

'The Development of Functional Dietary Components with waste/by-products of Fruit, Vegetable and Fish Processing' Charles O. Piggott et al. Poster presentation for 2nd Irish Fungal Group Meeting (13th June 2008).

Potential of fruit and vegetable waste and by-products from the Irish food industry as source of antioxidants and polyphenols. Hilde Wijngaard, Christian Rößle and Nigel Brunton. Oral presentation, 5th November, 2008, First European Food Congress, Ljubljana, Slovenia.

7. Compiled by: Dr. Nigel Brunton

Contact Nigel Brunton Email: nigel.brunton@teagasc.ie