Project number: 6594
Funding source: DAFM
Date: November 2015
Project dates: April 2014 – March 2015

Ready-to-bake mixes containing healthy flours generated from food processing by-products

Key external stakeholders:

Food manufacturers
Bakeries
Food ingredients companies

Practical implications for stakeholders:

The by-product material from food processing, and their use as functional ingredients, is an area that is currently attracting much interest. Information available on the characteristics of food by-products is comprehensive; however, information on the stability and shelf-life of food by-products is limited. The research findings from this project add to the scientific and technical knowledge base, and are of value to the those in the scientific/research community and food industry who have an interest in the area of functional ingredients.

The project took an innovative research approach in assessing the properties of by-products as ingredients in bakery mixes, and when packaged using different materials. This resulted in the development of new 'ready to bake' mixes containing novel ingredients.

Main results:

Flours derived from the dried by-products of food processing, in particular apple pomace, orange pomace and brewer's spent grain, were incorporated as baking ingredients into the following ready-to-bake-mixes:

- A soda bread mix containing 10% brewer's spent grain (BSG) flour (flour weight basis) and wheat flour.
- A yeasted brown bread mix containing 10% BSG and wheat flour.
- A scone mix containing 10% apple pomace (AP) flour and wheat flour.
- A cake/muffin mix containing 3.5% orange pomace flour (OP) and wheat flour. OP flour also replaced 40% of the fat normally used in a cake recipe.

The by-product flours were found to be suitable for incorporation into ready-to-bake mixes. These novel mixes offer a distinct advantage of producing baked products with enhanced nutritional quality (rich in dietary fibre and bioactive compounds) using natural functional ingredients. The flour mixes were stored using a range of different packaging materials, and their shelf life was observed to be highly stable.

Opportunity / Benefit:

Outputs from this project include the production of fully characterised and optimised novel bakery mixes ready for evaluation/validation/scale-up by flour/baking companies at a commercial level, while generating a potential profitable market for waste products for the bakery industry.

Collaborating Institutions: This project involved only Teagasc.

Contact Eimear Gallagher Email: Eimear.Gallagher@teagasc.ie

Teagasc project team: Dr. Eimear Gallagher
Dr. Anastasia Ktenioudaki

External collaborators:

1. Project background:

This project aimed to add value, through further research, to increase the commercial value/relevance of the outputs of a recently-completed FIRM project ('Healthy cereal-based snacks from by-products of the milling, malting, brewing and cider industries').

The nutritional and technological properties of the food by-products have previously been characterised and successfully incorporated into novel bakery formulations. The final step, and aim of this present project was to bring this work to a pre-commercial level and make it more applicable and relevant to industry. To do this, the objective was to apply these new formulations in an easy to use, healthy, ready-mix form, which would be commercially exploitable by relevant industry. These flour mixes aimed to produce baked products (sweet and savoury) requiring minimum addition of ingredients, equipment and time by the end user. The idea is based on the commercially available ready-to-bake-mixes such as soda bread mix, cake mix etc, and this project offers a distinct advantage of producing baked products with enhanced nutritional quality (rich in dietary fibre and bioactive compounds) using natural functional ingredients.

The project investigated the blending of the flours (e.g. apple pomace) with the other dry baking ingredients (e.g. sugar, salt, wheat flour etc) to form ready-to-bake mixes. The challenges that were addressed included the stability and the shelf-life of these flours when stored under different conditions (temperature, relative humidity and packaging). During storage, critical properties such as moisture content, water activity and peroxide value were monitored. In addition, the flour mixes were evaluated for their microbiological safety, sensory properties and nutrient stability. The effect of storage of the flour mixes on the quality of the baked products will also be studied.

2. Questions addressed by the project:

- What is the stability of dried by-products of food processing?
- How can they be incorporated into easy to use bakery mixes?

3. The experimental studies:

1. Optimisation of ready-to-bake flour mixes containing the by-product flours (apple pomace, orange pomace or brewer's spent grain):

Flours which were derived from the dried by-products of food processing, namely apple pomace, orange pomace and brewer's spent grain were prepared and incorporated as baking ingredients into the following ready-to-bake-mixes:

- A soda bread mix containing 10% brewer's spent grain (BSG) flour (flour weight basis) and wheat flour.
- A yeasted brown bread mix containing 10% BSG and wheat flour.
- A scone mix containing 10% apple pomace (AP) flour and wheat flour.
- A cake/muffin mix containing 3.5% orange pomace flour (OP) and wheat flour. OP flour also replaced 40% of the fat normally used in a cake recipe.

The quality of the baked products resulting from the above mixes was analysed. The four flours and the ready-to-bake mixes were stored in 3 packaging materials (with various barrier properties) over a period of 240 days at room temperature and relative humidity, to determine their stability and their shelf-life.

A parallel trial also took place where 3 types of scones were prepared with 10% AP, OP, and BSG respectively and tested separately. This was deemed appropriate to investigate the effect of storage on the flours only without interference from other baking ingredients and also as means to compare the different flours as baking ingredients. The tests were carried to investigate the baking and nutritional quality of the scones.

Contact Eimear Gallagher Email: Eimear.Gallagher@teagasc.ie

2. Identification of the stability of the ready-to-bake flour mixes in terms of their sensory and nutritional properties:
The flours (AP, OP, and BSG) were packaged in 3 packaging materials with different barrier properties. The selected packaging types were: Plain Paper: a plain paper bag used for storing commercially available flour mixes; Kraft Paper: a stand up pouch with bottom gusset and constructed from Kraft Paper and polyethylene and Matt White: a stand up pouch with bottom gusset comprised of Biaxially Oriented Polypropylene, metallized film Metallized Polyethylene terephthalate and polyethylene.

The flours were packaged in the 3 different packaging materials under constant room temperature (20°C) and relative humidity. Every month the flours were analysed for changes in moisture content, aw, colour, water binding capacity, total phenol content and oxidative rancidity. The flours were tested every 3 months for approximately 8 months (Days 0, 90, 180, and 240) for changes in volatile compounds and a microbial assessment also took place on these intervals.

4. Main results:

1. Optimisation of ready-to-bake flour mixes containing the by-product flours (apple pomace, orange pomace or brewer's spent grain):
Results of the baking properties in terms of volume, colour, texture and crumb structure highlighted the good quality of the products. The baked products were also deemed to be highly acceptable by panelists in terms of flavour, texture, appearance, aroma and overall acceptability.

BSG and AP flours were used as means of increasing the fibre content of the baked products. The results support the hypothesis and allow for sustaining a 'high fibre' claim for the ready-to-bake mix. The OP cake mix can be prepared with 40% less fat than a normal recipe which could possibly sustain a claim of a 'lower in fat' product'.

The by-product flours were found to be suitable for incorporation into ready-to-bake mixes. These novel mixes offer a distinct advantage of producing baked products with enhanced nutritional quality (rich in dietary fibre and bioactive compounds) using natural functional ingredients.

The three types of scones prepared with the flours from the three by-products had similar characteristics in terms of volume, texture and structure. The fibre content of all scone mixes was significantly increased.

2. Identification of the stability of the ready-to-bake flour mixes in terms of their sensory and nutritional properties:

The flours were stored in 3 packaging materials over a period of 240 days at room temperature and relative humidity. Changes in the physicochemical properties of the by-products flours were observed. Aw and moisture content increased with time, and the rate of increase was dependent on the barrier properties of the packaging material and the hygroscopicity of the flours. Colour was also affected in the case of OP flour; this was not dependent on the packaging material. The nutritional properties were not affected significantly by storage.

The baking properties of the four flour mixes were not affected by storage. However in the case of yeasted BSG bread, the stability of the dried yeast was an issue and affected the proofing time and as a consequence the final volume and texture of the breads. Overall however, the ready-to-bake mixes provided consistent results in terms of quality of the baked product and nutritional value.

The results of this task provide a comprehensive evaluation of the stability of novel by-products flours in different types of packaging. They are relevant to the end users as they provide evidence for their shelf-life and stability during storage. The research findings progress the new product development process and brings the ready-to-bake mixes to a pre-commercial level.

5. Opportunity/Benefit:

Following the use of novel 'by-product' ingredients and the development of a range of bakery mixes during this project, advice, consultancy work and/or technical services can now be provided at Ashtown in this area through Teagasc's fee-paying service. Commercial trials are ongoing in the test bakery at Ashtown.

Contact Eimear Gallagher Email: Eimear.Gallagher@teagasc.ie

6. Dissemination:

The outputs from this project continue to be disseminated in the form of scientific publications and via personal contact and outreach activities with the food industry.

Main publications:

Peer-reviewed publications:

Ktenioudaki, A., et al. (2015). Application of bioprocessing techniques (sourdough fermentation and technological aids) for brewers spent grain breads. Food Research International, 73 (7): 107–116.

Popular publications:

Presented at Teagasc Gateways Event, Dublin, June 2015.

7. Compiled by: Dr. Eimear Gallagher.

Contact Eimear Gallagher Email: Eimear.Gallagher@teagasc.ie