

Project number: 5964
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Healthy cereal-based snacks for the elderly



Key external stakeholders:

Food manufacturers
Bakeries
Food ingredients companies

Practical implications for stakeholders:

The rationale for undertaking the project was to address some widely documented nutritional concerns of the elderly, by developing soft textured, flavoursome and healthy baked products, and to gain a complete understanding as to their textural, sensory and processing properties.

It has been widely reported that undernutrition and malnutrition are widespread among the elderly in Europe, North America and other developed countries. Older people are unable to shop and cook properly to fulfill their nutritional needs. Barriers to healthy diets which have been identified include poor cooking skills, lack of motivation for shopping and poor housing conditions. As bakery products are commonly consumed (by people of all ages), and are widely available in local shops and supermarkets, they are obvious potential carriers for a range of functional ingredients directed towards health for the elderly. At the beginning of this project, a preliminary survey of existing snack-type products on the market revealed that no products were found that specifically targeted elderly consumers.

This project developed a range of healthy and novel baked and extruded products, which are convenient to eat, and targeted specifically at boosting the health of the elderly. The ingredients and formulations used in the project targeted specific areas of malnutrition in the elderly which have been highlighted in many current medical journals.

Main results:

This project has resulted in the formulation of a wide range of new baked products which are suitable for the elderly consumer. A particular focus was placed on texture and taste and resulted in the products being easy to bite/chew and having a highly acceptable flavour.

Opportunity / Benefit:

Outputs from this project include significant experience and a suite of techniques for producing novel healthy bakery formulations, with a particular focus on the elderly consumer. Knowledge with regards to ingredient interactions, and the generation of new products has been amassed.

Collaborating Institutions:

University College Cork.

Teagasc project team: Dr. Eimear Gallagher
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Dr. Frédéric Baudouin

External collaborators: Prof. Elke Arendt, UCC

1. Project background:

This project aimed to develop healthy and novel baked and extruded snack products, which are convenient to eat, and aimed specifically at boosting the health of the elderly. Throughout the duration of the project, dough rheology, staling trials and baking properties of the formulations were assessed using a range of scientific techniques, and sensory analysis of the products was also undertaken. At the same time, a fundamental scientific capability relating to the macromolecular properties, microstructure and nutritive/health aspects of the raw and finished products was developed. The ingredients and formulations used in the project targeted the specific areas of malnutrition in the elderly which have been highlighted in many medical journals recently.

2. Questions addressed by the project:

- What ingredients can be used to formulate appropriate baked and extruded products?
- What are the technological implications of formulating these new products?

3. The experimental studies:

Response surface methodology was applied to formulate novel buckwheat-based and corn-based snacks. A single screw extruder was used to create the new products. Initially, the extrusion method had to be addressed, focussing particularly on the feed rate, the extrusion temperatures, specific mechanical energy, and screw speed. Methods to determine the characteristics of the extrudates included expansion, bulk density, water absorption index and pasting properties.

During trials where high resistant starch bread rolls were produced, techniques involving dough rheological studies, baking trials/ingredient modification, digital imaging, shelf-life, microscopy, NMR and fibre studies were undertaken. When a range of lactic acid bacteria (LAB) were introduced to the formulation, in vitro digestibility studies, and in vitro predicted glycaemic index (GI) and glycaemic load (GL) were analysed.

The prebiotic effects and probiotic activity of ingredients in novel scone/quick bread formulations were determined, using a mixture design approach coupled with fructan analysis. The nutritional characteristics were also determined using lab-based methods, as both the fat and sugar were also reduced through the introduction of the prebiotic ingredients.

Soft bap-type products were formulated using techniques to introduce more fibrous ingredients (pea, barley, oat, cellulose fibres). During these trials, fundamental dough rheology of the new formulations was used to optimise water absorption. Also, crumb structure, storage characteristics and gassing power of the doughs and products were determined.

Symbiotic yoghurt/beverage products were developed using ingredient blending based initially on oat and quinoa milk. Their nutritional characteristics were determined. Following the introduction of LAB starters, relevant microbiology testing was undertaken: growth of the different strains was monitored, viscosity separation on a larger range of beverage products was completed, along with particle size, rheology and protein analysis.

Soft/crumby cookie type products were formulated with high fibre and high protein ingredients. New methods were used to characterise their eating properties. In particular, their acoustic attributes (which measured the sound the products make in the mouth once chewed) were recorded. The information garnered from this method was correlated with hardness/snapping/textural properties.

On all of the above products, a range of sensory techniques were used to evaluate the acceptance of the products.

4. Main results:

This project has resulted in the formulation of a wide range of new baked products which are suitable for the elderly consumer. A particular focus was placed on texture and taste and resulted in the products being easy to bite/chew and having a highly acceptable flavour. Also, new information relating to their optimal methods of processing and end product quality (rheology, physical characteristics, texture, shelf life, microstructure, sensory, nutritive properties etc) has been acquired.

In particular, the following products were developed and optimized:

1. Low GI, enhanced fibre extruded/puffed corn-based snacks with a low density (therefore easy to eat).
2. Soft, yeasted products containing resistant starch flours and increased fibre content.
3. Breads containing sourdough, and either teff/sorghum flours (significantly reduced in vitro predicted glycaemic index).
4. Cereal-based yoghurts with excellent nutritive and sensory properties.
5. Scones/quickbreads with reduced fat and sugar, and having pre-and probiotic effects.
6. Soft, semi-sweet baked products with extra fibre inclusions.
7. Crumbly cookies/biscuits with enhanced fibre and protein levels.

5. Opportunity/Benefit:

Following the use of ingredients and the development of a range of products 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.

6. Dissemination:

The outputs from this project continue to be disseminated in the form of scientific publications, oral presentations and via popular and technical publications.

Main publications:

Peer-reviewed publications:

Röbke, C., Ktenioudaki, A. and Gallagher, E. (2011). Inulin and oligofructose as fat and sugar substitutes in quick breads (scones): a mixture design approach. *European Food Research and Technology*, 233, (167-181).

Maekinen, O.E. and Arendt, E.K. (2012). Foods for special dietary needs: Non-dairy plant based milk substitutes and fermented dairy type products. *Critical Reviews in Food Science and Nutrition*, *in press*.

Mäkinen, O.E., Wanhalinna, V., Zannini, E. and Arendt, E.K. (2014). Foods for special dietary needs: Non-dairy plant based milk substitutes and fermented dairy type products. *Critical Reviews in Food Science and Nutrition*, (doi:10.1080/10408398.2012.761950).

Scientific abstracts:

Röbke, C., Ktenioudaki, A. and Gallagher, E. (2011). Inulin and oligofructose as fat and sugar substitutes in quick breads (scones): a mixture design approach. Cereal & Europe spring meeting. Freising, Germany, 11 – 13 April 2011. Oral presentation.

Röbke, C., Auty, M.A.E., Keller, D. and Gallagher, E. (2011). Development of fat and sugar reduced quick breads (scones) with potential pro- and prebiotic properties. Ageing globally – ageing locally conference. Dublin, Ireland, 2 & 3 November 2011. Oral presentation.

Mäkinen, O.E. and Arendt, E.K. (2011). Alternative cereals ingredient in the production of cereal milks. 10th European Young Cereal Scientists and Technologists Workshop. May 2011, Helsinki, Finland. Oral presentation.

Gallagher, E. and Roessle, C. (2012). The effect of extrusion conditions and buckwheat flour inclusions on the physical properties of corn-based snacks. Proceedings of the International Food Technologists Conference, Las Vegas, USA, July 2012. Poster presentation.

Mäkinen, O.E., Uniacke-Lowe, T., O'Mahony, J.A. and Arendt, E.K. (2013). Physical stability and acid

gelation properties of plant-based milk substitutes. C&E Spring Meeting, Leuven, Belgium, May 2013. Oral presentation.

Popular publications:

The Irish Examiner: (13/02/12). Irish food scientists develop prebiotic scones.

7. **Compiled by:** Dr. Eimear Gallagher.
