Project number: 5548
Funding source: EU FP6
Date: July, 2011
Project dates: Jan 2006 – Sep 2010

Novel fruit products from apples and other tree fruit (IsaFruit)

Key external stakeholders:

Vegetable processors, government authorities/legislators, consumers, food research scientists

Practical implications for stakeholders:

The project developed a number of fresh cut fruit salads and ready desserts products enriched with functional ingredients to capitalize on growing functional food markets. These products incorporated a range of functional ingredients including pre- and pro-biotics. An Irish based SME was involved in the development of these products and is interested in launching them when economic conditions improve.

Main results:

The project developed a number of fresh cut fruit salads and ready desserts products enriched with functional ingredients to capitalize on growing functional food markets. These products incorporated a range of functional ingredients including pre- and pro-biotics. An Irish based SME was involved in the development of these products. Fruit cultivars with optimal properties for the development of fruit based desserts and fresh cut salads were selected based on their sensory, physicochemical and quality attributes. Novel protocols were developed for incorporation of functional ingredients using technologies such as edible films and vacuum impregnation. Levels of functional ingredients were added at levels required to deliver the health benefit based on manufacturers' recommendations. At all points the sensory and quality attributes of the products were assessed to ensure that a real marketable product was being produced.

Opportunity / Benefit:

Fruits and fruit products are seen as healthy by consumers; however, if their market share is to grow they need to take advantage of the growing functional food market which fulfils consumer demands for products which deliver a health benefit beyond basic nutrition. The outcomes of the project demonstrated that fruit based functional foods with optimal functional, quality and sensory properties could be developed.

Collaborating Institutions:

UCD, Nature's Best Ltd, IRTA

Contact Nigel Brunton Email: dilip.rai@teagasc.ie

Teagasc project team: Dr. Nigel Brunton (PI)
Dr. Rona Gormley
Dr. Christian Roessle
Derek Keenan

External collaborators: Dr. Francis Butler, UCD
Paddy Callaghan, Natures Best Ltd.

1. Project background:

RMIS project 5548 was part of European integrated research project (IsaFruit) that focused on all aspects of fruit from its start as a seed till a consumer bites into a juicy end product. Approximately 200 researchers from 62 institutions and SME's in 16 countries were involved in the project that ran from January 2006 to the summer of 2010. ISAFRUIT's strategic objective was to increase fruit consumption, thus improving the health and well-being of Europeans and their environment, by taking a total chain approach, identifying the bottlenecks and addressing them by consumer-driven preferences. The TFRC component of the project dealt with the generation of new fresh cut and processed fruit products enhanced with functional ingredients (using freeze-chill, sous vide, and other techniques). The quality of these products was assessed using sensory and other instrumental techniques and the ultimate aim was to develop functional fruit based products to satisfy consumer demands for healthy non-dairy based products enhanced with functional ingredients.

2. Questions addressed by the project:

The project addressed a number of specific questions including:

- Can the quality of fruit products be improved while meeting the consumer preferences thus improving quality of selected processed fruit products?
- Can the convenience of fruit products be augmented by improving the quality and stability of minimally processed fruit and by developing novel convenient processed products with snacks characteristics?
- Can the availability of quality fruit be improved by means of developing minimally processed fruit and novel products?

3. The experimental studies:

The project developed a number of fresh cut fruit salads and ready desserts products enriched with functional ingredients to capitalise on growing functional food markets. These products incorporated a range of functional ingredients including pre- and pro-biotics. Fruit cultivars with optimal properties for the development of fruit based desserts and fresh cut salads were selected based on their sensory, physicochemical and quality attributes. Novel protocols were developed for incorporation of functional ingredients using technologies such as edible films and vacuum impregnation. Levels of functional ingredients were added at levels required to deliver the health benefit based on manufacturer's recommendations. At all points the sensory and quality attributes of the products were assessed to ensure that a real marketable product was being produced. The outcomes of the project demonstrated that fruit based functional foods with optimal functional, quality and sensory properties could be developed. Fruit based ready to eat desserts and fresh cut fruit salads were developed at the Teagasc Food Research Centre, Ashtown using ingredients sourced from a Belgium based SME (Beneo). The marketability of the products developed was assessed by an Irish based SME (Nature's Best). Novel processing protocols based on high hydrostatic pressure were developed at IRTA in Spain. In addition the microbiological quality of the products was optimised and assessed at IRTA.

4. Main results:

Results from the project proved that quality of minimally processed apples may be enhanced through selection of apple cultivars with low browning tendency and proper sensory parameters, texture was considered especially important. Tests with browning inhibitors and firming agents also showed potential usefulness. Apple desserts with nutraceuticals (BeneoHSI or with BeneoHSI + Beneo-Orafti) received acceptability scores equal to or better than the control; the inclusion of pomace on its own reduced acceptability. With peach, BeneoHSI improved sensory acceptability compared to the control. Trials conducted on the application of nutraceuticals to apple puree desserts processed by cook-chill, freeze-chill and sous vide proved that sous vide was the most satisfactory of the three processes in terms of logistics and product quality. For this reason, these trials were extended to plums and peaches. In all deserts there

Contact Nigel Brunton Email: dilip.rai@teagasc.ie

was excellent oligosaccharide retention (at least 94%) and this was attributed to the mild sous vide process.

Minimally processed fresh-cut apple wedges containing nutraceuticals, namely BeneoTM P95, which is a prebiotic, dietary fibre and sweetener were developed. Apple circles were produced containing BeneoTM P95 and Aquamin (highly available algal calcium) using laboratory scale equipment. The task here was to apply the prebiotic to apple wedges using pilot scale vacuum infusion equipment, i.e. Inject Star vacuum tumbler. The infusion trial gave apple wedges with a modest content of BeneoTM P95 (and hence a modest prebiotic effect) in the absence of AS1; the content of infused BeneoTM P95 was lower in the presence of AS1 (browning inhibitor). The level of BeneoTM P95 infusion in the wedges was less than that found previously for Braeburn circles (thinner cross section than wedges). The trial with edible coatings applied to apple wedges gave mixed results. The alginate used had good adherence to the apple wedges but did not totally overcome the translucency problem found in vacuum-infused apple wedges.

Probiotic apple wedges containing the micro-organism *Lactobacillus rhamnosus* were developed. Such a product is desirable in the market place as many consumers are allergic or intolerant to dairy products and are precluded from eating probiotic yoghurts. Probiotic apple slices are thus an alternative for people allergic to dairy products. Physicochemical and sensory evaluation indicated that dipping apple slices in a probiotic solution resulted in slices of acceptable quality with sufficient numbers of *Lb. rhamnosus* adsorbed on the surface for a probiotic effect.

Another product developed was a so called synbiotic fresh-cut apple wedges (D3..1.42) containing probiotic bacteria (*Lactobacillus rhamnosus*) and prebiotics in the form of oligofructose and inulin. Synbiotic fresh-cut apple wedges with a shelf life of at least 14d/2-4ºC were successfully produced in these trials. Fructan analysis showed that the prebiotic inclusions in the apple wedges remained relatively stable over 14 days at 2-4ºC. All samples sets contained ca. 10^8 cfu/g of probiotic bacteria over the test period, which is sufficient for a probiotic effect, and is comparable to counts of probiotic bacteria in commercially available dairy products. Browning index, firmness, acidity and dry matter remained stable throughout the 14 days, and applying prebiotic coatings resulted in an increase in soluble solids in the wedges. Sensory assessment indicated that synbiotic apple wedges had high levels of acceptability. HPLC analysis showed that levels of polyphenolic compounds in the apple wedges decreased during storage but no differences were found in O_2 and CO_2 headspace concentrations or in volatile production/loss in packs of synbiotic or probiotic apple wedges.

5. Opportunity/Benefit:

This project demonstrated that fruit based functional foods with optimal functional, quality and sensory properties could be developed. Work on minimally processed fruit desserts was successful and among the new products developed are fruit salads with neutraceutical and other bioactive compounds. Probiotic apple wedges containing *Lactobacillus rhamnosus* are an alternative for people allergic or intolerant to dairy products and are highly desirable in the market place.

6. Dissemination:

Main publications:

Keenan, D. F., Brunton, N. P., Gormley, T. R., Butler, F., Tiwari, B. K., & Patras, A. (2010). 'Effect of thermal and high hydrostatic pressure processing on antioxidant activity and colour of fruit smoothies' *Innovative Food Science & Emerging Technologies* **11(4)**: 551-556.

Roessle, C., Auty, M. A. E., Brunton, N., Gormley, R. T., & Butler, F. (2010). Evaluation of fresh-cut apple slices enriched with probiotic bacteria. *Innovative Food Science & Emerging Technologies*, **11(1)**: 203-209.

Roessle, C., Brunton, N., Gormley, R. T., Ross, P. R., & Butler, F. (2010). 'Development of potentially synbiotic fresh-cut apple slices' *Journal of Functional Foods*, **2(4):** 245-254.

Popular publications:

Gormley, R., Keenan, D., Röble, C., Brunton, N., Picouet, P., Landl, A., Abadias, M., Viñas, I., Sanchis, V., Callaghan, P., Markowski, J., Plocharski, W., Kolodziejczyk, K., & Kosmala, M. (2009). Co-operation ISAFRUIT. *Food Science and Technology*, 23(3), 26-28.

Stahel, S. and Gormlet T.R. Honeysweet apple slices:a new addition to the fruit salad range. *TResearch* Vol 3(1) Spring 2008, 12-15.

7. Compiled by: Dr. Nigel Brunton and Dilip Rai

Contact Nigel Brunton Email: dilip.rai@teagasc.ie