Ready-meals, both chilled and frozen, are well established in the international market report by Marina Braida and Ronan Gormley of Ashtown Food Research Centre in Dublin.

intel data shows that the value of the frozen ready-meals market in the UK has been reduced by the effect of price promotion, while chilled ready-meals continue to be a big rival in the market place. This has caused the main players to diversify into premium and luxury range prepared meals. The developing market for food in central and Eastern Europe may also represent an opportunity for increased sales of these products.

Most ready-meals are made up of a combination of carbohydrate (eg rice, potato or pasta), protein (fish or meat), vegetables and sauce. Despite increasing awareness of the health benefits from eating fish, ready-meals containing fish are less common than those containing chicken or beef and the appearance of such fish meals on the market are a relatively recent occurrence.

**Phases of sous vide and freeze-chilling**

R&D on ready-meals has been a major focus at Ashtown Food Research Centre (AFRC) for a number of years. Much of the activity has been focused on freeze-chilling, which is a combination of freezing and chilling as the name suggests. This gives major logistical benefits for the processor as large amounts of a particular ready-meal can be produced, held in deep freeze, and then lots can be tempered and released into the chill chains as required, ie the consumer buys the meal as a chilled product.

R&D shows that freeze-chilling is a safe and suitable technology for most types of ready-meal and also for other products such as fresh fish fillets held in modified atmosphere packs (MAP).

Trials have also been conducted on fish processed by sous vide technology which ensures a gentle and low temperature process that causes minimal damage to the product in terms of nutritious value and sensory properties. A number of fish species in gourmet sauces have been processed at AFRC by sous vide technology with good outcomes.

Going beyond 'low fat'

WE are in the era of 'healthy choices' and ready-meal companies are responding to this with meals containing reduced salt and calories. However, companies are only just beginning to realize the potential of ready-meals as carriers of functional (healthy) ingredients and nutraceuticals. Such meals have applications in all sectors of the community but especially to the elderly who may find meal preparation difficult and who may also be lacking in trace minerals and other nutritives (eg dietary fibre). The production of such enriched meals is likely to be a major growth area in the near future especially when the inherent health benefits of fish are superimposed, in these items become 'doubly' attractive.

These drivers led to the current study at AFRC on the formulation, preparation and freeze-chilling of a gluten-free salmon lasagne containing nutraceuticals and also a sous vide processed ready meal of the same formulation but with Rigati pasta instead of sheets (still gluten-free). The gluten-free aspect was introduced as intolerance to gluten and to flour-containing products is becoming more widespread in Europe. For example, one in 60 people in Ireland is a diagnosed coeliac and it is suspected that a much higher number are undiagnosed, in latent coeliac. The research was conducted in association with Irish ready-meal producer, Dawn Fresh Foods as part of the EU-funded Seafoodplus project.

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**THE TRIAL - LASAGNE FORMULATION**

The gluten-free salmon lasagne (50% of which was salmon mince), bechamel sauce, gluten free pasta sheets and suitably cooked Chinese-style salmon fillets were cooked at standard conditions to provide a commercial sample of conventional salmon lasagne and the gluten-free version. The gluten-free pasta sheets were adequate for the evening meal. Based on these responses, an average portion size was calculated as being 244 g.

The nutraceutical targets were based on 400 g of lasagne (416 g of bechamel sauce). These were vegetable (7%), fibre (4.4%), calcium (0.13%), and iron (0.15%). Calcium and vegetale fibre are both good sources of dietary fibre and in such desirable as the diet. Science of Ireland is an alignment between functional foods and nutrient-dense fibre and protein properties, ie it encourages growth and production of beneficial gut bacteria in daily intake. Calcium and iron are essential for cardiovascular health and for the daily requirement has been largely shown to be healthy. Calcium deficiency is a major function in young infants, hence the inclusion of 1 mg in the current study. Arabinose (Margarine, Coop) is derived from soft rice and is available in a form of calcium as grown in Britain and used in the lactose-free variant.

Béchamel sauce

Initially the tests were on the Béchamel sauce component of the lasagne as it was used as the carrier for the nutraceuticals. Physico-chemical and taste panel tests were conducted to study how the sauce properties were influenced by the gluten free ingredients and by the nutraceutical inclusions. The gluten-free sauce was compared by sensory using a control heat source for a specified period and contained stirred milk powder (1%), cheese powder, fromage blanc, sunflower oil and water (this experimental version replaced SMP, wheat flour, sunflower oil and water).

The gluten-free Béchamel sauce was less viscous than its wheat-containing counterpart as indicated by handheld viscometer readings (speed 2) of 35 vs 49 Pa.s respectively at 55°C and 72 vs 94 Pa.s at 70°C. The effect was more pronounced using the Brookfield viscometer system (Stable Micro Systems, Surrey, UK) in Brookfield mode (arbitrary scale) (1%) at 55°C vs 80°C and 75 vs 80°C. The gluten-free sauce was slightly whiter than the wheat-containing sauce and had a higher whiteness, yellowness (6%) ratio (measured colour meter 6% in K6.5, 6.9 of 12.1 vs 9.3). A triangle taste panel indicated a difference between the sauces with 13 out of 11 testers correctly identifying the odd sample in each trial. The extent of the difference was considered large by the taste, moderate by 1 and no comment by three. However, the difference was not significant in a preference test with eight testers preferring the gluten-free sauce and two having no preference. Both sauces exhibited sheen forming, in they thickened on standing.

**Effect of inclusions**

A range of inclusions were added to the sauce, both individually and together (Table 3). All of the inclusions (moderately) increased fibre content except the pectin.,
place and competition is strong both in terms of choice and price. But in this special show that there is more than one way to add value to these products.

### Salmon lasagne with nutraceuticals

Gulfinic free pasta sheets were cooked in boiling water containing a small amount of salt for 9-10 minutes. The lasagne was formulated as outlined above and the cooked gluten-free pasta sheets were bonded with salmon sauce (in between, then then coated with Oregano sauce containing the nutraceuticals, which was was mixed with a mixture of Oregano sauce) and a commercial ready to use pancake in the form of a storage solution (5% fish sauce and 5% fish paste) per 40 g of product. The mixture was then kept at room temperature for 7 days and then kept in the refrigerator for 2 weeks. The water was drained and the mixture was then placed in a plastic bag and processed in a vacuum drum, then kept at room temperature for 48 hours. The finished product was then kept at room temperature for 48 hours before being frozen. The finished product was then stored in a freezer for 48 hours before being consumed.

### Sous vide salmon ready-meal with nutraceuticals

Sous vide Salmon ready-meal with nutraceuticals. The product was prepared by immersing the fish in a solution of salt and fish sauce (5% fish sauce and 5% fish paste) per 40 g of product. The mixture was then kept at room temperature for 7 days and then kept in the refrigerator for 2 weeks. The water was drained and the mixture was then placed in a plastic bag and processed in a vacuum drum, then kept at room temperature for 48 hours. The finished product was then kept at room temperature for 48 hours before being frozen. The finished product was then stored in a freezer for 48 hours before being consumed.

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### Salmon sauce

SALMON sauce (SAL,salmon content) was added to the finished product in a vacuum drum at 45°C and then kept overnight at 5°C.