Plant protein ingredients

Pea proteins
Roquette produces plant proteins based on four plant-based sources: pea, wheat, corn and potato. Its NUTRALYS® pea protein is a range of plant protein ingredients sourced from the sustainable yellow pea, through the company’s patented water-based process. A range of plant protein ingredients, including soluble, insoluble, textural and functional forms are produced for applications in, for example, meat products, snacks and cereals, sports and slimming foods, clinical nutrition products, vegetarian foods, gluten-free foods, soups and sauces.

Until now, the main restriction on the use of plant proteins has been their taste – this can vary slightly, depending on botanical origin, but it has always had an unattractive odour and a so-called green (or vegetable) sensory note. The origin of the undesirable ‘green’ note is linked to certain naturally-present volatile molecules, such as hexanal. Roquette technology has made it possible to exclude these, from raw material to the protein.

Properties
The Roquette pea protein is highly purified (85% as dry matter). It displays technological properties suitable for dairy-like product processing and possesses the emulsifying properties and viscosity necessary for a creamy texture.

Pea protein helps stabilise emulsions and has inherently free-flowing properties, which makes the lecithin or other additives and flow agents required in milk and soya protein unnecessary. It is also very easily dispersed, with no dust, lumps or foam formation, making it easy to use in manufacturing environments.

The Roquette process for manufacturing pea protein results in a highly purified pea protein with a high amino acid score of 93 for adults. Unlike other vegetable protein sources, it has a very low anti-nutritional factor content and high digestibility: approximately 98% – better than whole peas or pea flour and comparable to the best animal protein source. The amino acid profile of pea protein is well balanced and fulfils the requirements for adults.

Laetitia Guérin-Deremaux of Roquette explains the useful properties of pea protein as a food ingredient and describes a study investigating the effect of pea protein on satiety and weight management.
defined by the World Health Organisation.

**Applications**

Pea proteins have a wide range of applications, including alternatives to dairy proteins, plant-based meats, weight management, sports nutrition and senior and clinical nutrition. This article describes a study investigating the potential of pea protein to tackle weight management and obesity. Obesity and its comorbidities have become a worldwide public health problem – both in the developed and the developing world. According to the WHO\(^1\), the prevalence of obesity has nearly tripled since 1975 and almost 2.8m people die each year as a result of being overweight or obese. In 2016, 41m children under the age of five were overweight or obese. In 2016, more than 1.9bn adults were overweight, of these 650m were obese. In such an alarming context, official bodies and the food industry are having, and will have, vital roles to play in fighting the trend.

National educational campaigns targeting the modifications of behaviour and habits, especially in the developed world, have been and still are favoured by governments. Unfortunately, a strong body of evidence suggests that education alone does not produce the results so urgently required. Taxation on junk food has been tried in many countries for a number of years in order to discourage unhealthy eating. However, it has generally failed in curbing obesity and changing consumer behaviour for different reasons. Legal measures, already popular in some high-income countries, are interestingly now also being applied in middle- and low-income countries around the world. Chile has led the way: in December 2013, a law on the nutritional composition of food and its Advertising came into force requiring a warning icon to be displayed on unbalanced food products that exceed the nutrient profile set per serving size. In addition, foods that do so may not be advertised to children under 14 years of age, and not at all inside schools.

**Weight management strategies**

One way to tackle overweight and obesity is to better manage our body weight. To achieve this goal, three different steps have to be considered:

- Decrease caloric intake
- Manage the feeling of hunger
- Achieve satiety – the opposite of hunger: the feeling of fullness which arises when eating a meal. The sooner we feel full, the sooner we stop eating and so the fewer calories we consume. It is the management of these three steps that is key to addressing the obesity problem.

To meet the needs of an increasing market demand for solutions to weight management, understanding and clarifying the possible roles of relevant ingredients is increasingly important. Proteins alone or in combination with fibres are one of the top ingredients used in the weight management sector.

**Pea protein and satiety**

As already stated, satiety plays a central role in obesity prevention. It is already established that certain food ingredients, such as the animal proteins in milk, can be an effective way of achieving it.

What about plant-based ones? Roquette has been investigating the impact of its pea protein on satiety for several years and has previously shown that it may trigger satiating hormonal responses similar to those of whey\(^2\). In collaborative work with the Leatherhead Food Research Centre, Roquette has been investigating the impact of its pea protein on satiety for several years and has previously shown that it may trigger satiating hormonal responses similar to those of whey.

Pea protein and satiety

Roquette’s Nutrition Team has demonstrated that its pea protein may provide an alternative, non-animal way to induce satiety in humans\(^3\). This was achieved in an experimental vegetable soup incorporating the pea protein.

**Study design**

Thirty-six healthy volunteers with a BMI between 18.5 and 25 were enrolled in a randomised double-blind cross-over clinical trial, according to precise inclusion and exclusion criteria, excluding eating disorders. Randomisation was based on sex, age and BMI. The volunteers were each invited to consume on separate occasions in a randomised order one of four different vegetable soups containing either:

- 15g of NUTRALYS®
- 30g of NUTRALYS®
- 30g of whey protein
- maltodextrin instead of protein (as a control).

All products tested were formulated to be isocaloric with 200kcal per portion and all were equivalent in viscosity and taste. Each serving of 55g was reconstituted in 300ml of hot water (Table 1).

The clinical trial was scheduled for weekly visits over four weeks. To guarantee comparable situations, specific instructions were given about diet and physical activity in the days preceding the experimental visits. Volunteers were asked to arrive at the research centre for a standardised breakfast. Then at 11am they were given the soup preload and at 2pm an ad libitum lunch.

**Procedure**

The experimental procedure ran as follows:

- Satiety was evaluated during the entire day from breakfast to the end of lunch by using visual analogue scales, where the volunteer had to place a cursor.
- Volunteers were asked several questions such as ‘How full do you feel?’, to which their answers might range from ‘I’m not full at all’ to ‘I’m very full’.
- Blood samples were collected several times before the preload and until the end of lunch in order to measure the satiety hormones.
- Finally, the quantity of food consumed during the lunch was recorded to evaluate the caloric intake.
- Drink was limited to water at 150ml per hour.

**Results**

<table>
<thead>
<tr>
<th></th>
<th>Per serving</th>
<th>No protein soup (control)</th>
<th>Soup containing 15g of NUTRALYS® pea protein</th>
<th>Soup containing 30g of NUTRALYS® pea protein</th>
<th>Soup containing 30g of whey protein</th>
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</thead>
<tbody>
<tr>
<td>Total protein</td>
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<td>17.5</td>
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<td>NUTRALYS® pea</td>
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<td>30.0</td>
<td>29.6</td>
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<tr>
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<td>2.8</td>
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<tr>
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<td>1.3</td>
<td>3.3</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 Composition of the soups
Satiety evaluation

Figure 1 displays the different answers to the question ‘how full do you feel?’ following the consumption of the preload soups: the control preload tends to be less filling than the soup containing 30g NUTRALYS® but not statistically significant (p=0.058).

The soup containing 30g of NUTRALYS® was perceived to induce greater fullness than the 15g dose (the light green line – p<0.05), but also fullness comparable with the 30g whey dose (represented by the grey line – p>0.05).

Impact of first serving of soup on the next meal

After consumption of a preload soup enriched with proteins, volunteers had a lower caloric intake at the subsequent ad libitum lunch (three hours after the preload) than after consumption of the control soup. The effect was reinforced when the protein dose in the soup was increased.

The bar chart (Figure 2) shows that the caloric intake in the 30g NUTRALYS® dose group was 10% less than that in the control. Moreover, this reduction was similar to that produced by the 30g whey dose.

Impact of the soup on the satiety hormone

Cholecystokinin (CCK) is a peptide hormone of the gastrointestinal system responsible for stimulating the digestion of fat and protein. Its concentration in blood is a biomarker recognised as an accurate measure of the impact of a food on satiety.

Levels of this hormone in volunteer blood were measured between soup consumption and the end of the subsequent ad libitum meal.

As shown in Figure 3, the concentration of CCK in the 30g NUTRALYS® group was similar to that observed in the whey group and tended to be higher than that of the control.

This result may explain the beneficial effect of the NUTRALYS® soup on satiety and the reduction of the caloric intake that had been observed previously.

Conclusions

Pea protein offers a sustainable alternative to meat and dairy protein sources in many food applications. It possesses a number of favourable properties for formulation of foods, including a balanced amino acid profile, high digestibility, ease of dispersion and a lower cost than dairy proteins. Studies investigating the effect of pea protein on satiety have indicated that pea protein added in a preload soup induced a significant decrease of caloric intake in the follow-on meal – to a similar extent to whey proteins. This property could be useful in management of obesity.