SUSTAINABLE PRODUCTION & HEALTHY EATING
FACT SHEET



SHEET NO. 2

This fact sheet is one of a series compiled by the Food Innovation Centre at the University of Nottingham, providing clear, concise and scientifically reliable information on key topics for SMEs

Plant-based proteins & meat alternatives

What are plant-based proteins?

Plant-based proteins are proteins sourced from plants, and made of a chain of amino acids. These sources include:

- **Legumes -** e.g. soy, pea, lentils, chickpea, and beans
- **Nuts and seeds -** e.g. almond nut, chia and pumpkin seeds
- **Cereal and grains -** e.g. rice, wheat and oat
- **Seaweeds and algae -** sold as sea vegetables and plant-based proteins

When these plant proteins are processed after being mixed with other ingredients such as oil, they can produce 'meat analogues', 'veggie burgers' and other plant-based meat alternatives.

Why is plant-based protein important?

- **Environmental benefits:** Exploration of plant-based protein sources and their derived protein product development, would help reduce Green House Gas (GHG) Emissions, and also conserves earth's fresh water and land resources. In contrast, animal agriculture is responsible for more GHG emissions than the entire transportation sector.
- **Personal health benefits:** Plant based proteins are generally nutritious and healthy. Adoption of a more plant-based diet has reported links to human's health. For example, an appropriately planned plant-based diet could help manage, prevent, and in some cases even reverse/cure health conditions such as diabetes, obesity, heart diseases and cancer. It also reduces/avoids the ingestion of potentially harmful antibiotics from meat consumption.
- **Animal welfare and religious consideration:** Reducing the slaughter of animals/livestock, resulting in a more ethical conscious lifestyle (animal welfare). Moreover, for religious considerations, it would provide more products and purchase options for some particular religious groups with dietary laws (e.g. Hindu, Sikh etc consumers).

Healthy Eating Fact: Each day, a person who eats a plant-based diet saves 1100 gallons of water, 45lbs of grain, 30 sq ft of forested land, 20lbs of CO_2 equivalent, and one animal's life.

Plant eating trends & plant-based protein market

'UK Diet trends 2021' (Finder survey), reports that an increasing number of British consumers are embracing a more plant-based diet. The UK is around 3% vegan, 6% vegetarian, 4% pescatarian, and 30% flexitarian (reducing meat intake).

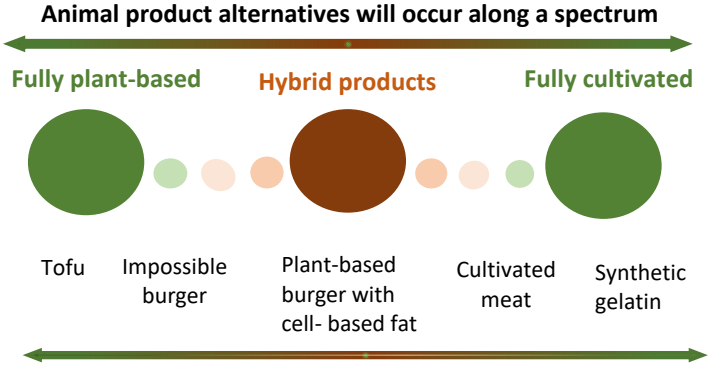
The COVID-19 pandemic is expected to accelerate these trends as consumers are becoming more aware of their personal health, linking a heathy diet to immune response. The main market drivers include, consumers become more health conscious and environmentally aware, as well as the significant venture investment in plant-based product manufacturers. Mintel market analysts have projected that the global plant-based market will be worth £54 bn by 2027, the current biggest categories are plant-based milk and plant-based meat.

SME opportunities: protein options vs selection

- **Plant-based options:** soybean, pea, rice, hemp, chia seed, flaxseed, pumpkin seed, sesame, sacha inchi, almond, fava bean, mung bean, corn protein, potato protein, oat and wheat protein, plant protein hydrolysates etc. (Table on protein options and comparisons is available via the given contacts below).
- **Selection:** SMEs can select the most suitable plant protein source(s) based on the use, nutritional value, cost, availability, sustainability and functionality for the specific food applications. It maybe that a mixed solution is required to balance these factors for decision making.
- **Use & Food applications:** Protein sources are usually used in the form(s) of whole seeds, powder/flour, and/or protein concentrate/isolates. These forms will vary in protein concentration and functional properties, therefore having different commercial prices. The main food applications include: meat alternatives, dairy alternatives and plant-based eggs.

Meat alternatives

Animal product alternatives will occur along a spectrum



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Sustainable Production & Healthy Eating: Plant-based proteins & meat alternatives

Meat analogues

- **Traditional:** Fully plant-based products such as Tofu, tempeh, seitan, have been consumed for many years, especially in Asia, and have established the market share. **Modern:** More advanced and modern plant-based meat alternative (meat free) brands are emerging and under development in recent years. For example, Beyond Meat, The Impossible Burger, Tyson Foods, Seamore, Meatless Farm, THIS™, Moving Mountains etc.

- **Meat hybrid products** (product where some meat has been replaced by plant ingredients - proteins/fibres etc) bridge the gap of animal-based meat products and meat free alternatives. It also has an increasing market share, which mainly responds to growing flexitarian demand, the most popular hybrid product being sausage.
- **Future:** Cultured meat, meat grown using stem cell technology through cell and tissue engineering techniques, has great potential as a meat alternative in the future. Also, edible insects have long been consumed in the global south and east, but innovation may allow them to spread into other markets. There are increasing number of edible insect-based start-ups in western countries including the UK in recent years.

Dairy alternatives

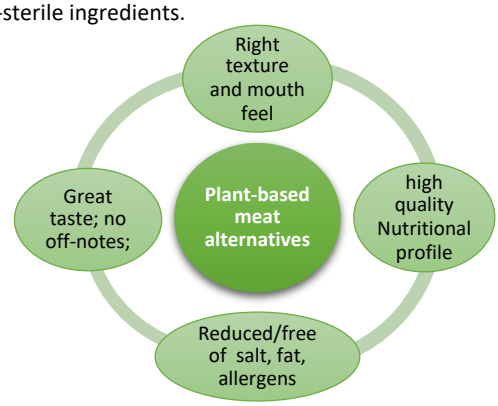
Plant-based proteins have also been widely used in dairy alternatives innovation including plant-based milks, vegan cheese and butter or other plant-based drinks. Currently two approaches (i.e. using isolated plant proteins or oil bodies) are normally considered by food businesses to produce plant-based milks.

Factors to consider

- **Sensory aspects & Consumer acceptance:** plant proteins generally have off-notes, it is important to understand the ingredients used, and the process applied in order to deliver great taste and flavour while maintaining a good nutritional profile, and managing salt and fat levels.

- **Technical challenges:** creating a meat-like structure/texture, and a meat-like appearance and flavour is the key. **Extruder** is currently a widely used technique in food industries. Other new technologies including **shear cell technology, wet spinning and 3D Printing** are also under development.

- **Food safety & Food allergies: 1)** Allergen information must be clearly labelled on products. Consumers may be allergic to ingredients such as wheat, soy etc. **2)** Plant based meat alternatives often have a high risk of microbial growth and reproduction as they generally provide a high moisture environment and a neutral pH, further thermal treatment is recommended after the post-extrusion process and the addition of non-sterile ingredients.




Plant-based burger


Meat analogue

Plant-based milks

- **Anti-nutritional factors (ANF):** plant protein sources, especially legumes, generally contain a high concentration of ANFs (e.g. phytic acid, tannins, phenols and trypsin inhibitors). These ANFs can reduce the digestion and absorption of nutrients e.g. proteins/amino acids and minerals (e.g. zinc and iron). The removal of ANFs and/or minimisation of their impact is achievable by using different processing methods.
- **Protein quantity vs Protein quality:** people often focus on the protein content in different protein sources, and the daily intake of protein, but pay less attention to protein quality: **1) Nutritional profile/balance:** some plant proteins are not complete protein (do not contain all essential amino acids), and may cause vitamin B12, and Fe deficiency issues due to lack of certain micronutrients. **2) Digestibility and bioavailability:** Protein digestion efficiency also reflects protein quality, and is important for health, which in turn, links to sustainable production.
- **Novel Food Application:** Use of Novel food/protein ingredients may trigger the need for a novel food application and approval.
- **Cost, availability and convenience:** These factors are also important for SMEs to consider, as it directly affects the consumers' choice and market saleability.

How are plant-based proteins/products regulated?

In the UK, plant-based products are currently regulated by the Food Standards Agency (FSA). Food processors are required to have a risk based preventive food system in place. A discussion and Legislation is underway in the UK on what can be called a 'burger', 'meat' and 'sausage' or similar terms. The old regulation 258/97 in EU (applied from 1997 to 2017) was replaced by a new regulation 2015/2283 since Jan 2018. In Oct 2020, the European Parliament has voted to ban dairy-related terms and names e.g. 'milk', 'cheese', 'butter', and yogurt' for purely plant-based products, while 'meaty' terms such as ' veggie burger', 'sausage' and 'steak' will continue to be allowed for plant-based products.

Social aspects

Consumers' food choices are complex by nature, and are affected by many factors; health, taste, accessibility, convenience and price being the main issues. Shifting to a healthier, sustainable way of eating as a society is a big challenge. This needs effort from consumers, but also government, by implementing measures such as sin taxes and health subsidies; a sustained social marketing campaign; public education and clearer nutritional labelling to help change consumers food choices and lead to a reduction in meat consumption with a more sustainable food system.

Resources

Wentao Liu(2021) 'Plant based protein & Meat Alternative'. In: Wentao Liu (2021) 'Healthy Eating '.

Contacts & further information

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click here for: Future Protein Platform led by Prof. Andrew Salter
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To download this document, the main reference guide and more:
https://www.nottingham.ac.uk/fic/research-healthy-eating.aspx

If you want to know more and have issues you wish to discuss, contact the Food Innovation Team who may be able to help