

# SEFARI



Leading ideas on food



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## Leading ideas on food

The Scottish Environment, Food and Agriculture Research Institutes (SEFARI) is a collective of six research institutes, each with their own global capability, expertise and reputation.

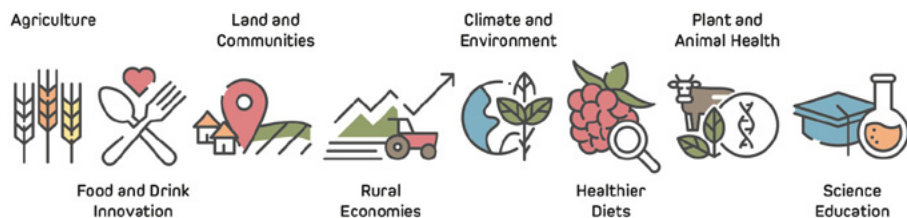
The six institutes are:

- Biomathematics and Statistics Scotland
- James Hutton Institute
- Moredun Research Institute
- Rowett Institute
- Royal Botanic Garden Edinburgh
- Scotland's Rural College

Through collaborative interdisciplinary research, SEFARI are responsible, with Higher Education Institute partners, for delivering the Scottish Government (Rural and Environment Science and Analytical Services, RESAS) funded Strategic Research Portfolio on environment, agriculture, land, food, and rural communities (2016-2021). The Portfolio includes the Strategic Research Programme, Centres of Expertise, Innovation Partnerships and Underpinning Capacity funding of national resources within SEFARI.

The SEFARI Gateway is the knowledge exchange and impact hub for SEFARI. The Gateway works to enhance stakeholder access to the expertise of the Portfolio; to improve the flow of research and knowledge to and from the portfolio across Scotland's policy, industry-sector and public audiences and to increase the impacts from those activities. Gateway also seeks to ensure that Portfolio research is actively informed by stakeholders and knowledge networks across Scotland, UK and internationally.

### SEFARI focuses its work under eight 'Leading Ideas'



With examples from our 'Agriculture', 'Food and Drink Innovation', 'Climate and Environment', 'Healthier Diets' and 'Plant and Animal Health', this leaflet highlights SEFARI Scottish Government funded strategic research ensuring we have healthy diets that are safe, nutritious and environmentally and economically sustainable.




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### Contact us

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## Improving berry health benefits

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SEFARI researchers have an international reputation in soft fruit crop improvement for yield, quality, resource use efficiency and pest and disease resistance. This involves and benefits from close relationships with breeding and agronomy companies, government agencies and national and international stakeholders.

Recently, application of innovative biomedical, molecular and processing technologies has identified new functional properties potentially linked to human health in berry products as well as routes to adding value to lower quality and unused biomass.

In particular:

- A raspberry component, salidroside, exerts health positive effects in models of Huntington's Disease
- The development of genetic markers for salidroside content, could be used to breed high-salidroside raspberry varieties
- There is a potential role of berry polyphenols in neuroprotection of brain function
- Studies in young healthy human volunteers have revealed the effects of blackcurrant juice more broadly on attention, mood and brain activity

Leveraged from Strategic Research Portfolio research and its underpinning of SEFARI researcher expertise, a EU funded OPTIBERRY project ('Optimal use of by-products of berry fruit production') aims to use crop waste or co-product (e.g. sustainable berry biomass, such as non-premium fruit) to develop innovative production and processing approaches with the potential to support new food and non-food ingredients.

## Plant protein's role in diet diversification

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High protein plants have the potential to help meet increasing food production requirements, while mitigating greenhouse gas emissions, increasing nutritional qualities and diversity of crops available to growers and consumers. Several high-protein plants can be grown in Scotland, these include; fava bean, buckwheat, hemp and green pea. SEFARI research has shown:

- Healthy eating and weight management can be achieved with a diet supplemented with plant-based protein. Plant protein is satiating and can offer a similar amino acid profile to animal protein. Several protein-rich plants are high in fibre and bioactive phytochemicals, which can bring additional health benefits for both gut and systemic health
- Agricultural hemp (*Cannabis sativa* L.) in addition to being a low-carbon crop, has an excellent nutritional profile. Being rich in protein (36%), fibre (26%) and micronutrient minerals (magnesium, calcium and zinc), it provides an opportunity for new product development and diet diversification

Functional ingredients from high-protein plants are currently being tested in a range of products, which may offer healthier food choices for people with non-communicable disorders such as type 2 diabetes and cardiovascular disease.

Partnership working and building networks of knowledge are key to informing our research and those who use it. For example our researchers were founding members of the Scottish Hemp Group that welcomes all sectors from primary producers to consumers. The group's mission is "to support and promote hemp in Scotland for food, feed, energy, biomaterials and as a cash-crop promoter of circular green economies and new markets".





## Helping consumers make healthier and sustainable purchases

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Despite national dietary guidelines, our typical diet still contains too many calories, saturated fat, salt and sugar, whilst having insufficient amounts of fibre, fruits, vegetables and fish. Advice for healthier diets proliferates, but many people may not know how to make sense of all these messages, how reliable they are and how to use them. SEFARI scientists have created a way to support consumers in making better nutritional choices.

- A new tool has been developed, 'Number Muncher Diets' creating an individual, healthy and green weekly shopping list using mathematical methods to optimise environmental impact or cost, while ensuring dietary recommendations and personal preferences are met
- Users are offered an initial suggested shopping list, and presented with information on its nutrient composition, greenhouse gas impact and cost. Further constraints can be added regarding specific dietary requirements. A new shopping list is then created, and this process can continue until a diet which is both satisfactory to the user's needs and meets all nutritional requirements has been achieved

There are many diet formulation websites and apps, with this tool being unique as it is underpinned by robust nutrition science, mathematical methods and underwritten by policy bodies. Furthermore, this tool offers additional functions as it also allows for users' personal interests in the carbon footprint of foods, and affordability. Future work will see the tool developed further to enable importing of online grocery lists so swaps can be made in real time by consumers.

## Ensuring cereal food safety

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Mycotoxins are fungal contaminants of cereals which pose a significant issue for UK primary agricultural production and a potential food safety risk. SEFARI research has assessed different aspects of the mycotoxin issue from primary agricultural production to food products and the effects of human exposure, this includes:

- Frequent co-occurrence of free and plant-bound masked mycotoxins in cereals
- Masked mycotoxins are not absorbed from the gut intact however, once they come into contact with the human gut microbiota, the free toxins are readily released and are then able to be absorbed

Findings are being utilised by industry as well as by policy makers to ensure the production of safe, high quality food and are important in protecting consumers from high exposure. A workshop jointly organised with Food Standards Scotland brought together representatives from industry, research and Government has highlighted the need for a rapid testing tool for free and masked mycotoxins to reduce supply chain disruptions and ensure food safety.



## Improving sustainable roundworm control for 'Scotch Lamb'

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Roundworms are arguably one of the most important production-limiting disease syndromes globally. Control of these infections commonly relies on the use of anthelmintics, but uptake of diagnostic tools to aid the choice and timing of treatment are poor. A barrier to the uptake of these tools is a lack of awareness among producers of the many benefits which can be realised.

- Interactive worm control workshops were developed for UK sheep farmers by SEFARI scientists, to highlight the costs and benefits associated with using diagnostic faecal worm egg counts (FWEC) and Electronic Identification (EID) to assist in the development of sustainable worm control strategies
- The strength of the workshop was that it provided time and training to farmers to enable them to get their 'hands dirty' by doing faecal egg counts on samples from their own flocks

Following the success of the two Scottish workshops, further workshops were held throughout the UK supported by wide range of stakeholders such as supermarkets, pharmaceutical companies, veterinarians and Registered Animal Medicines Advisors.



# Improving 'Scotch Beef' environmental impact

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Beef production is very important for Scotland's economy (economic output of £851 million in 2017) and for providing the high quality and iconic 'Scotch Beef' brand. However, it is widely recognised that there is an environmental impact caused by cattle through their production of methane. Methane is a highly potent greenhouse gas (GHG) produced by ruminants and a reduction of these emissions will help to meet the legally binding Scottish Government target of net-zero GHG emissions by 2045 to limit climate change.

The cow's largest stomach, the rumen contains a very dense microbial ecosystem comprising of different Bacteria, Archaea, Protozoa and Fungi. This ecosystem within the rumen is essential in cattle due to its ability to convert indigestible fibrous plant material (e.g. grass) into absorbable nutrients used to produce high quality beef. As a by-product of the microbial conversion of feed, in particular fibrous grass, the rumen microbial Archaea population produces methane, which is expelled through mouth and nose into the environment.

In collaboration with the Universities of Edinburgh and Aberdeen, SEFARI scientist's prize winning and subsequent research showed that efficient beef production with less methane emissions is achievable by:

- Genetic improvement of animals for increased feed conversion efficiency which produce more meat per kg of feed consumed using the correlated abundances of specific microbes and their genes present in the rumen
- Selection for lower abundance of key microbes and their genes involved in producing substrates needed by Archaea so that they produce less methane in the rumen of cattle

This research provides new breeding strategies to improve the sustainability of Scottish beef production in terms of efficiency and mitigation of GHG emissions. The breeding strategy is cost-effective because it avoids expensive measurements of feed conversion efficiency using electronic feeders and methane emissions in respiration chambers. Rumen microbial genes are also excellent biomarkers for animal health (including antimicrobial resistance) and welfare traits, as well as meat fatty acid profiles ensuring healthier human diets.



# Healthy benefits of dietary fibre

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Healthy weight management for many people is extremely difficult with most diets failing in the long run. Investigations aimed at enhancing satiety and weight loss have found protein to be effective, but the effects of fibre have been unclear.

SEFARI scientists investigated the potential benefits of supplementary soluble indigestible fibres from fruit and cereals and specifically their ability to enhance satiety, reduce effects of metabolic syndrome and alleviate fatty liver disease using laboratory rats. The use of an appropriate animal model, where diets and intakes were precisely controlled, avoided dietary compliance issues that are often confounding in human studies.

SEFARI research has found:

- Fibre supplements were more effective at promoting weight loss and satiety alone than protein supplements
- Added dietary fibre elevated gut derived satiety hormone signals, which could lead to reduced energy intake and weight loss, although studies conducted elsewhere have seen elevated satiety signals without weight loss
- Expression levels for many genes change in the liver following fibre consumption, including several genes associated with improving fatty liver disease

Current studies are investigating if the associated weight loss is dependent on the presence in the gut of specific bacteria that can use the fibre to produce novel compounds, in addition to short chain fatty acids, that affect satiety or fat metabolism.

