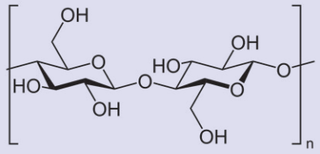
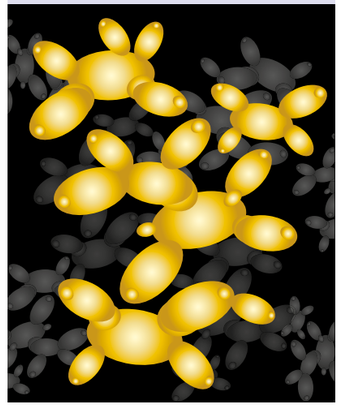
Improving the nutritional profile and healthiness of processed meat products

Dr Benjamin Bohrer of Ohio State University studies how nutritional and health-benefiting ingredients can be incorporated into processed meat systems. In particular, his work focuses on how a plant-based dietary fibre, beta glucan, can be added to meat products without impacting the characteristics of the product. Understanding more about this process will enable it to be optimised further, ultimately leading to the possibility of a processed meat product which would confer health benefits to the consumer.





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Dr Bohrer's most recent work explored the properties of soluble fibre beta glucan (above: chemical structure and illustration).

Approximately 25% of the meat products consumed in the USA are processed meat products. Foods such as ham, salami, tinned meat and meat-based sauces are classed as processed meats, meaning that they have been modified to either extend their shelf life or change their taste. One example of further processing of meat products involves the addition of non-meat products, such as salt, sugars and spices. Many of these ingredients are used due to their ability to interact with the different nutritional components of meat, including fats, proteins and water – a process which defines the palatability and acceptability of processed meat products.

These ingredients modify the meat product to improve sensory attributes, shelf life and product functionality. Product functionality includes attributes such as pH, water holding capacity, rheology during heating/cooling and texture. Processing of meat products can also ensure they meet food safety standards. In addition to creating desirable traits, for example better taste, processing can also add value to meat products.

Processed meat products have a reputation for being unhealthy due to their high salt and saturated fat content, and many studies have shown that a diet high in processed meats is linked to increased risk of diseases such as cardiovascular disease. Dr Benjamin Bohrer, Assistant Professor in the Department of Animal Sciences at the Ohio State University, aims to address some of the challenges faced by the meat processing industry and to provide opportunities to modernise many traditional methods. His research group uses a combinational approach, taking into account food structures, the interactive effects of ingredients in the food matrix (the complex physical and chemical interactions that happen between compounds in a food) and processing techniques used by the meat industry.

BIOACTIVE FOOD INGREDIENTS

Dr Bohrer's work focuses on the incorporation of ingredients into meat products to improve nutritional value and confer health benefits. These ingredients are often called 'bioactive' food ingredients, meaning that they confer some sort of health benefit to the consumer.

One category of non-meat ingredients that can be added to processed meat products is dietary fibre, a nutrient well known to have many health benefits, including the reduction of cardiovascular disease, improved gut health and reduced risk of some cancers such as colon cancer. As most people do not reach the recommended intake of fibre, this would be a novel and effective way to increase dietary fibre intake. Dietary fibre can be further separated into two categories – insoluble fibre and soluble fibre.

Soluble fibre is a form of carbohydrate which cannot be digested by the body but does interact with water to form a gel. This gel has many health benefits including improved digestion, cholesterol levels and heart health. Good sources of soluble fibre include many fruits and vegetables, as well as nuts, seeds and oats. In particular, oats

	Carb./g	Protein/g	Fat/g	Fiber/g	Iron (% daily req.)	Others
Bran	63	16	3	43	59	vitamin Bs
Endosperm	79	7	0	4	7	
Germ	52	23	10	14	35	vitamin Bs omega-3/6 lipids

Nutritional Value (per 100g)

contain a source of soluble fibre called beta glucan, and it is this compound that the Bohrer research group along with collaborators from Brazil (Dr Alicia de Francisco) and Colombia (Dr Sandra Vásquez Mejía) choose to focus on.

BETA GLUCAN

Dr Bohrer's most recent work explored properties of beta glucan obtained from cereals, including the extraction, degradation and utilisation of soluble fibre in food products. Given its gel-forming properties, beta glucan can also be used in food products as a thickener, texture enhancer or stabilising agent. While it has successfully been incorporated into carbohydrate-based foods, such as pasta, there are still challenges to incorporating beta glucan into high-protein foods, such as meat and dairy products.

Dr Bohrer analysed the existing studies that have investigated beta glucan. He concluded that the main challenges are the ability to incorporate enough fibre to have a meaningful impact on human health, combinations of other ingredients that may interact with beta glucan and preventing the degradation of added soluble fibre during processing.

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The researchers realised that there may be interactions between beta glucan and proteins in food, impacting the incorporation of soluble fibre into foods. However, the research on this topic is scarce and more studies are needed to better understand interactions within the food matrix.

A balance needs to be achieved between adding sufficient soluble fibre to provide health benefits while avoiding significant changes to texture and other characteristics of the product, especially given its emulsifying and thickening abilities.

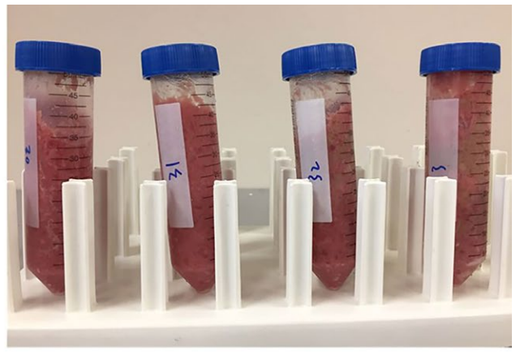
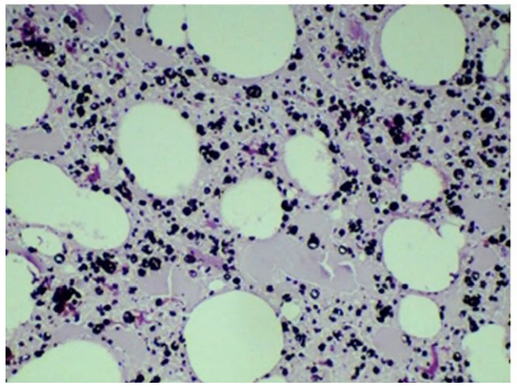
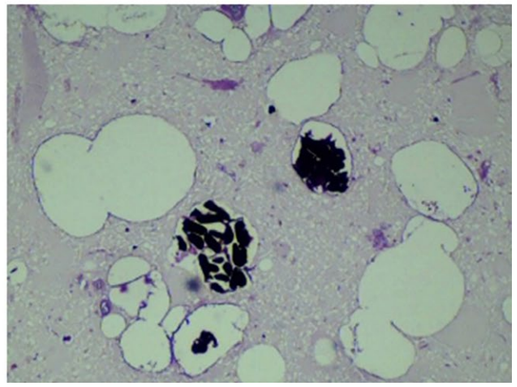
FOOD MODELLING SYSTEMS

Food modelling systems provide a way to determine how ingredients and processing alter the characteristics of the final product, as well as evaluating how easily these characteristics are influenced by changes to the above.

To improve understanding of the effects that incorporation of beta glucan can have on the physical and chemical properties of a meat emulsion (raw beef, fat/oil, water and salts), Dr Bohrer and colleagues selected the best model to describe the cooking loss, colour and texture of meat emulsions with added beta glucan. They found that emulsions with greater levels of beta glucan and starch were slightly harder, more cohesive and springier than emulsions without these ingredients. The model was able to optimise the amounts of beta glucan and starch needed to provide health benefits while maintaining appropriate characteristics, a finding that can be used to inform industrial food processing methods.

A further study undertaken by Dr Bohrer explored the possibility of incorporating beta glucan into chicken breasts, and how this may change the physical, chemical, thermal and microbiological properties of the meat. The research group stored the meat in a fridge for 9 days and investigated the differences when a variety of concentrations of beta glucan were added, with or without salt. The results showed that colour, pH and bacteria count were hardly affected by treatment, and that incorporation of beta glucan actually improved water retention levels. However, while most beta glucan was



Dr Bohrer's research team uses meat modelling systems to address research question related to ingredients. Pictured above are examples of laboratory techniques that are utilised by the research team to assess rheology (top left), emulsion stability (top right), and microstructure (bottom).

retained during storage, much of the dietary fibre was lost during cooking. This suggests that there is still more work to be done to develop methods which allow beta glucan to be injected into meat products and retained during and after cooking.

The results of multiple studies showed that beta glucan has the potential to replace starch in processed meat products as it does not impact upon texture or taste. Further studies are needed to thoroughly evaluate the properties of beta glucan to optimise its incorporation into food products and to overcome barriers, such as the need to reach a sufficiently high level of beta glucan in a food to ensure that it meets criteria to be labelled as an enriched or fortified product.

A MOVE TOWARDS NATURAL INGREDIENTS

This novel approach to meat processing has the potential to significantly improve the nutritional composition of meat products. Given that there is a likely link between socioeconomic status and intake of processed meat products, this could also help broach some of the health inequalities seen between different populations.

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In recent years, there has been a focus on the use of 'natural' ingredients rather than 'synthetic' ingredients, providing support for further research into incorporation of beta glucan into foods. Indeed, it also has the potential to act as a vessel for other health-benefiting ingredients, for example fish oils or probiotics. Other carbohydrates, such as starches, are already used in food processing, so replacing them with an ingredient that has health benefits and many of the same functional properties provides an attractive alternative for optimising processed meat products. In addition, plant-based sources of fibre are cheaper and more easily obtained than other carbohydrate ingredients.

While the incorporation of dietary fibre in processed meat products shows promise for encouraging consumers to meet their daily recommended intake of fibre, more work is still needed to overcome the challenges involved in this, including ensuring that fibre remains after processing and that there are minimal effects on the physical and chemical properties of the product.

Behind the Research

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Research Objectives

Dr Bohrer studies how nutritional and health-benefiting ingredients may be incorporated into processed meat systems.

Detail

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Bio
Dr Benjamin Bohrer is an Assistant Professor in the Department of Animal Sciences at The Ohio State University. Dr Bohrer completed his formal education in animal sciences focusing on meat science and muscle biology at the University of Illinois at Urbana-Champaign (PhD).

Funding
- Natural Sciences and Engineering Research Council (NSERC) of Canada

Collaborators
- Dr Sandra Vásquez Mejía
- Dr Alicia de Francisco
- Dr Claudio Gabiatti Jr.
- Dr Shiqi Huang

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Personal Response

In addition to beta glucan, what other bioactive food ingredients do you think would be beneficial to incorporate into processed meat, as well as other processed products?

"The utilisation of bioactive compounds is an emerging area of emphasis for the food processing industry. Bioactive compounds can be broadly defined as biologically active constituents in foods or dietary supplements, other than those needed to meet basic human nutritional needs, which are responsible for changes in health status. There are many examples of bioactive compounds that have been tested for use in food processing. Examples specific to meat products include fatty acids [specifically long-chain polyunsaturated fatty acids like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)], vitamins and minerals (specifically through food fortification), plant-derived antioxidants, dietary fibre, probiotics, and bioactive peptides. It should also be mentioned that the source of bioactive compounds (i.e. the actual ingredients and foods which the compounds are derived from) and methods used to obtain and isolate the bioactive compounds can be equally interesting and important."

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