Our food, drink and nutraceutical innovation services

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Our support for food, drink and nutraceuticals

Accelerating product innovation

Supporting supply chain resilience by developing smarter, healthier and sustainable ingredients and packaging.

Enabling resource efficiency

Accelerating the adoption of advanced manufacturing systems to reduce waste and address climate change mitigation.

Ensuring product safety and security

Supporting state-of-art product, analytical process and packaging innovation to ensure food safety, product authenticity and traceability.

Adding value by accelerating product innovation

Supporting innovative and resilient food supply chain for the 21st century

New and smarter ingredients

Supporting sustainable manufacturing and formulation solutions

Health and wellbeing innovation

Supporting nutritionally balanced products

Understanding trends and drivers

Supporting sustainable food systems and packing, and technologies to understand and meet consumer habits

Smart and sustainable packaging

Supporting the development of next generation packaging materials and technologies

Next generation retail

Enabling a digital platform and small-scale digitally-enabled test-beds for personalised products/formulation

New and smarter ingredients

Support to develop sustainable and scalable processes and products for new food ingredients, flavours, fragrances and nutraceuticals. We can help with formulating or reformulating; assessing impact on flavour modulation, delivery and controlled release.

Benefit from our experience in state-of-art manufacturing and scale-up facilities, synthetic biology, and formulation science.

- Differentiation
- Environmental
- Regulation
- Time to market
- Brand identity

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Health and wellbeing innovation

Supporting the process development of microbiome-based probiotics, alternative proteins, nutraceuticals and food supplements. Benefit from our extensive experience in formulation or reformulation to develop nutritionally balanced products.

Benefit from our experience in state-of-art manufacturing and scale-up facilities, synthetic biology, and formulation science.

Financial | Differentiation | Time to market

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Understand consumer trends and drivers

Supporting you to develop products that help address sustainable customer market trends to reduce environmental impact.

Benefit from our smart packaging solutions to enable and encourage consumers to interact with your packaging, building brand confidence and loyalty, and providing information on customer habits and trends.

- Differentiation
- Environmental
- Regulation
- Brand identity

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Smart and sustainable packaging

Helping you develop smart packaging solutions to reduce waste, enhance supply chain security and efficiency and build customer confidence and brand loyalty.

Benefit from our formulation and biotechnology capability and reduce your environmental impact by developing sustainable packaging and coatings that are recyclable, compostable or biodegradable

Differentiation

Environmental

Regulation

Brand identity

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Next generation retail

Benefit from our digital platform and small-scale, digitally-enabled testbed for do-it-yourself (DIY) formulation for personalised products targeting unmet consumer needs or made to order from components or ingredients produced and stored in multiple, distributed facilities.

Differentiation

Brand identity

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Adding value through resource efficiency

Supporting a resource-efficient food manufacturing supply chain

Manufacturing of the future

Accelerating the adoption of new advanced manufacturing solutions

Waste minimisation

Optimise manufacturing processes to be as efficient as possible

Climate change mitigation

Solutions looking to reduce environmental impact

Manufacturing of the future

Utilise our state-of-art manufacturing facilities equipped with sensors to maximise your productivity, deliver flexibility and agility, and reduce downtime.

Leverage our expertise on instrumentation, measurement, digital and accelerated testing to optimise products and processes.

- Financial
- Differentiation
- Environmental
- Time to market

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Waste minimisation

Utilise our state-of-art digitally enabled manufacturing facilities to maximise productivity, deliver flexibility and agility, and reduce downtime and waste and maintaining manufacturing quality.

Leverage on our expertise on biotechnology, packaging, instrumentation, measurement, and accelerated testing to optimise products and processes.

Financial

Environmental

Helping to mitigate climate change

Utilise our minimal and intensified processing technologies, coatings and predictive modelling capability to help improve your manufacturing and cleaning, and reduce energy and water consumption.

Reducing resource requirements and transportation costs by adopting formulation driven approaches to food dehydration.

Financial

Differentiation

Environmental

Time to market

Let's innovate together
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Adding value through resource efficiency

Supporting a resource-efficient food manufacturing supply chain

Food Safety

Supporting solutions that are related to manufacture, measurement and tracking

Authenticity & Traceability

Accelerating intelligent packaging adoption to monitor authenticity and traceability

Food safety

Benefit from our synthetic biology capability to develop sustainable alternative proteins for easier traceability. Utilise our advanced analytical and instrumentation capabilities for ingredient traceability and preventing food cross contamination, foreign object detection or chemical and microbial contaminations.

Benefit from our smart packaging and formulation capability for to prolong product shelf-life, accurate labelling, traceability and enhance supply chain security.

Differentiation | Regulation | Brand identity

Authenticity and traceability

Benefit from our smart packaging capability to monitor traceability and authenticity of product labelling, condition monitoring, and enhanced supply chain security.

- Financial
- Differentiation
- Regulation
- Brand identity

Innovating together with CPI

CASE STUDY

Developing sustainable feed stock ingredients

Demonstration of a gas fermentation process followed by the design and build of Calysta's novel-size loop reactor at our Wilton site in only 18 months.

CALYSTA

Commercial project

Outcomes and impact

- *Production of 1 tonne of FeedKind protein product*
- *New product brought to market*
- *£40 million private sector investment secured*

Innovating together with CPI

CASE STUDY

High performance thin film coatings for metal packaging

Application of novel materials and processes to develop a next generation thin film barrier coating to give improved protection against corrosion of the metal packaging.

Thomas Swan

CROWN
Brand-Building Packaging™

AkzoNobel

Collaborative R&D project

-

£800,000

Outcomes and impact

- *Enabling the development of effective barrier coatings free from safety concerns of existing material*

Our food, drink and nutraceutical capabilities

Our food, drink and nutraceuticals offer

Sustainable and functional ingredients

- Alternative proteins
  (Single cell protein meat substitutes and extracts, including plants, algae, and fungi; precision fermentation of animal-free dairy, egg, and collagen; and cultured meat products)
- Functional ingredients
  (Enzymes, vitamins, sweeteners; and pigments, flavours, and fragrances)

Formulation of food, feed and drink

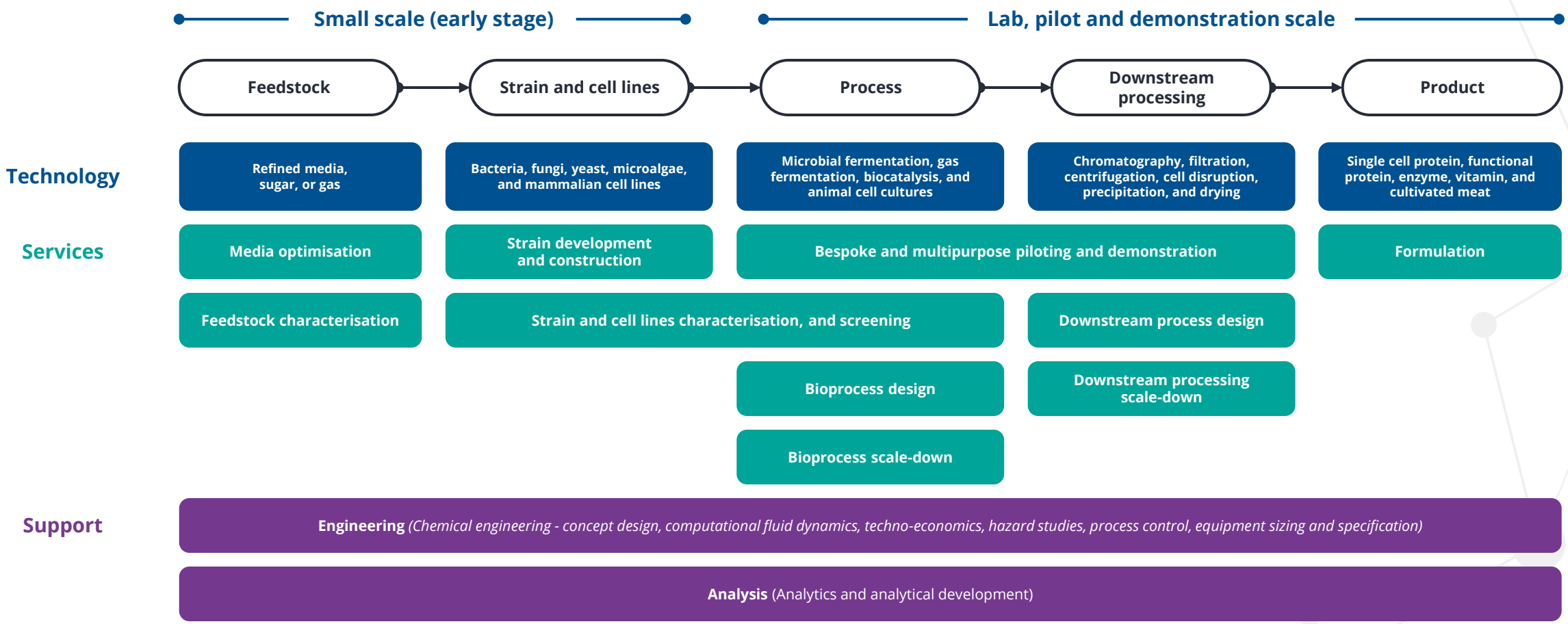
- Processed foods
  (Confectionery; and sauces, spreads, and pastes)
- Drinks and beverages
  (Soft drinks and formula)
- Nutraceuticals and supplements

Logistics and packaging

We offer further capabilities in logistics and packaging, include applications for:

- Sustainable feedstocks
- Monomers and polymers
- New materials development
- Recycling

Sustainable and functional ingredients



Breadth of our support services

Helping create **market-ready** products with our extensive **technology process options**

Cell banking

- Validation
- Strain security

Process, cell line, and strain screening

- Host strain selection, development, and optimisation
- Cell line selection

Process optimisation

- Improved yield
- Improved efficiency

Downstream processing (DSP)

- Separation
- Extraction
- Purification

Engineering support for lab to commercial production

- Techno-economic assessment *(TEA)*
- Computational modelling *(CFD, DEM, FEA)*
- Engineering design *(Concept, feasibility, and front-end engineering studies)*

1 mL to 10 L scale-down

- Process understanding
- Process de-risking
- High-throughput process

Analytical support

- Molecular and elemental analysis
- Microbiology
- Metabolomics and proteomics

HACCP

- Traceability and control
- Food grade standards Coming 2021

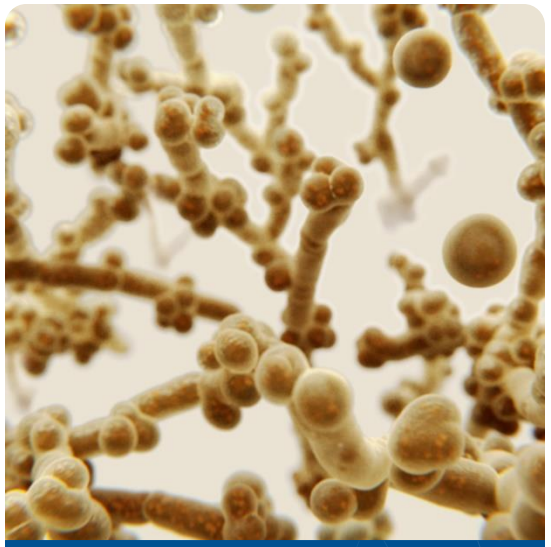
750 L to 10,000 L scale-up and demonstration

- Proof of concept
- Production of testing material

Formulation

- Performance by design
- Advanced process development

Processes for alternatives to animal products



Biomass fermentation

with sustainable processes for single cell protein and protein rich extracts from yeast, bacteria, fungi, or microalgae

Precision fermentation

for functional ingredients and recombinant animal or plant proteins from microbial cultures

Downstream processing

for plant protein extraction and biomass processing

Cultivated meat

through animal cell cultures

Our capabilities in biomass fermentation

Biomass fermentation for alternative proteins

From strain selection to demonstration-scale production of food and feed products including fungi, yeast, bacteria, and algae.

Whole cell products – Developing processes for the production of microbial biomass products such as single cell proteins and protein-rich extracts

Alternative feedstocks – Using C1 and other sustainable feedstocks for microbial fermentations for food and feed products using non-standard microbial hosts

Strain improvement – Using non-GM adaptive evolution based approaches

Our facilities supporting biomass fermentation

Biomass fermentation for alternative proteins

Bioprocessing and gas fermentation laboratories – 0.5 – 10 litre fermentation for host strain and bioprocess characterisation and development, including gas fermentation with comprehensive analytical suite

Pilot plant – 10, 20, 50, and 750 litre fermenters with associated downstream processing

Demonstration plant – 10,000 litre fermenter with associated upstream and downstream processing

Scale-down downstream processing – Development suite with small-scale DSP equipment mimicking on-plant DSP facilities

Flexible plug-and-play

24/7 shift operations team

Feed production standards

At CPI, safety is our number one priority.

Our facilities are certified to **ISO 9001** and **FSSC 22000** standards *"for the production of single or multiple products, whether processed, semi-processed or raw, which are intended to be fed to food producing animal."*

These certifications ensure our production of safe and good quality feed products.

Feed business establishment
for the production of microbial cell protein

Dedicated food and feed
safety team and quality manager

Expertise in
HACCP assessment

Committed to
FSSC 22000
for food and feed

Our capabilities in gas fermentation

Gas fermentation for a circular economy

Comprehensive gas fermentation services from initial screening to C1 gas demonstration.

Initial screening – Feedstocks, microbial host chassis, and growth media screening

Media and fermentation optimisation

Process scale-up and demonstration - Bio-material generation scale-up processes for regulatory approval and market entry test

Our facilities supporting gas fermentation

Gas fermentation for a circular economy

Gas fermentation development laboratory

SIP fermenters – Batch fermentation ranging from 5 to 10 litres

High-throughput fermenters – 0.5 and 1 litre capabilities for operating in batch, fed-batch, and continuous modes from ambient up to 10 bar pressure

Microwell-based screening system – Modified system to run C1 gases safely

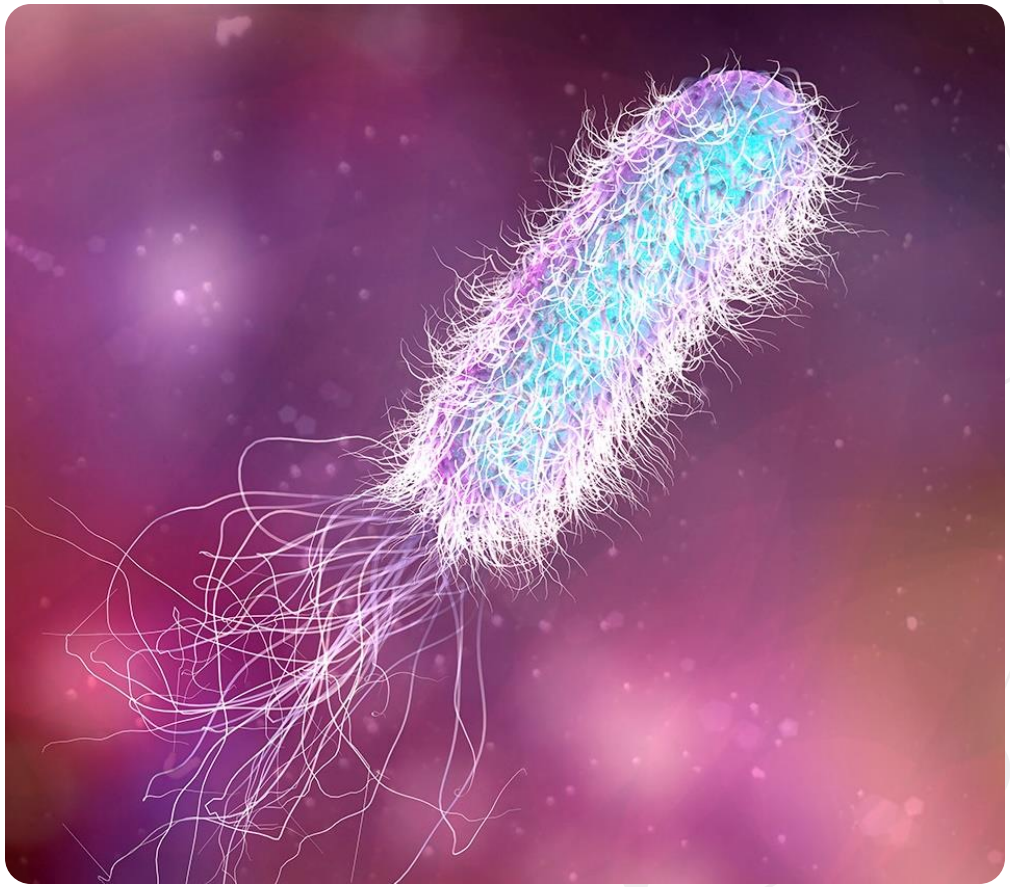
Safety engineered and HAZOP assessed – Gas fermentation facility with multiple alarms, trips and soft sensors to ensure a safe working environment and regulatory compliance

Our capabilities in precision fermentation

Precision fermentation for functional ingredients and recombinant proteins

Host strain development services for dairy and egg proteins, collagen, enzymes, vitamins, alternative sweeteners, and pigments.

- **Precision fermentation expertise** – using a range of yeast, bacteria, microalgae and fungi in the production of ingredients that include food proteins, enzymes, growth factors, and vitamins
- **Production optimisation** – for the development of strains, and upstream and downstream processes using a range of food-relevant microorganisms
- **Molecular biology expertise** – for strain design and construction with a range of microorganisms
- **Biotransformation development** – for the production of functional ingredients
- **Adaptive laboratory evolution** – using non-GMO strain development



Our facilities supporting precision fermentation

Precision fermentation for functional ingredients and recombinant animal protein

- **Automated microbioreactors** – 15 mL and 250 mL bioreactors for rapid and high-throughput analysis, and DoE of strains and processes
- **Microwell-based culture vessels** – for the screening of strains and processes
- **Bioreactors** – 1 L vessels for fermentation process development
- **Fully-equipped lab space** – for molecular biology and microbiology
- **Analytical labs** – for metabolomics, process development, and product analysis

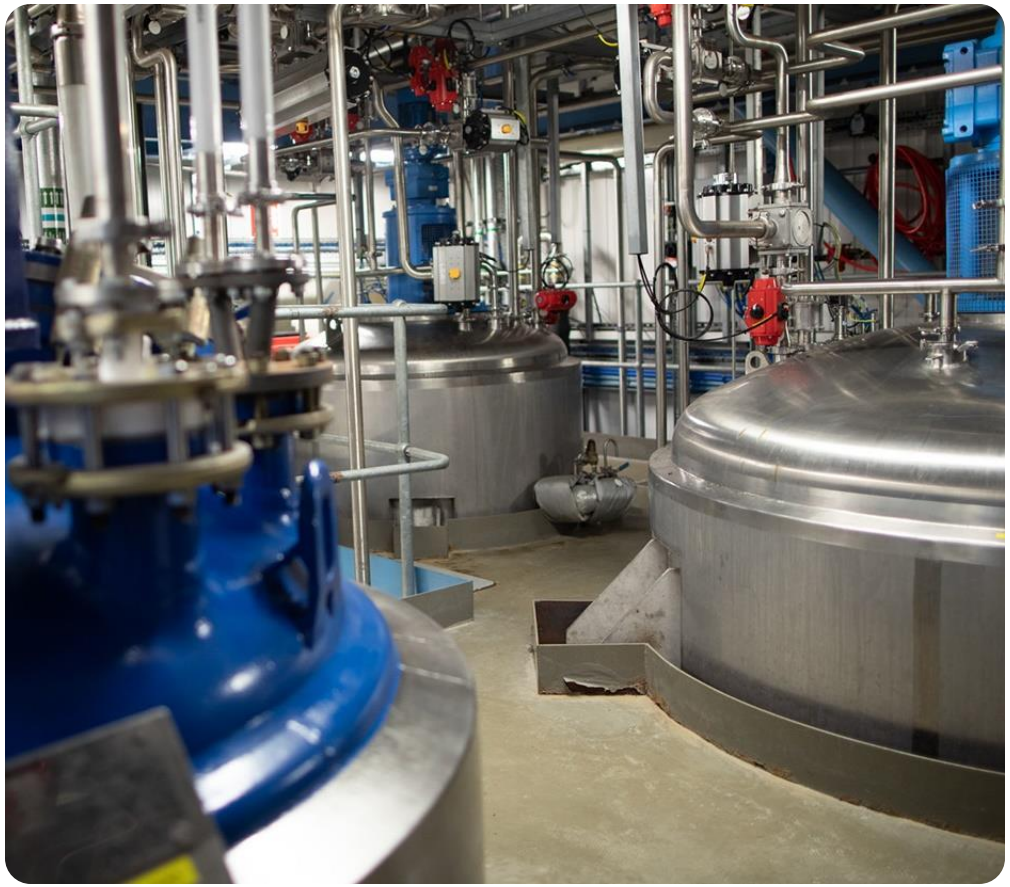
Our capabilities in downstream processing

Downstream processing for plant protein extraction and biomass processing

Downstream processing (DSP) capabilities for the isolation and purification of proteins, oils, and carbohydrates, to **separate, extract, purify**, and **concentrate** using:

- Bead milling
- High shear mixing
- Homogenisation
- Disc stack centrifugation
- Enzymatic extraction
- Decanter centrifugation
- Filter press
- Depth filtration
- Sterile filtration
- Precipitation
- Tangential flow filtration
- Charged filtration
- Ultrafiltration and diafiltration
- Column chromatography
- Freeze and spray drying
- Normal flow filtration
- Membrane chromatography
- Liquid-liquid extraction
- Microfiltration
- Solvent extraction

Our facilities supporting downstream processing



Downstream processing for plant protein extraction and biomass processing

Developing scalable downstream processes (DSP) – Dedicated facility with laboratory-based DSP equipment to help de-risk scale-up

Pilot-scale DSP suite – Servicing of upstream feedstock with 1,000+ litre capacity, and a plug and play suite that allows for mobile equipment use

Demonstration-scale DSP suite – Servicing upstream feedstock with 10,000+ litre volumes, fixed DSP equipment, and a plug and play system for mobile equipment use

DSP equipment at a variety of scales – We have a wide selection of equipment ready to use, and key supplier relationships to ensure we can meet the bespoke demands of each bioprocess

Our capabilities in cultivated meat products

Animal cell cultures for sustainable meat production

- **Process development and scale-up** – for animal cell culture processes including adherent, microcarrier, and suspension-based systems
- **Media screening and optimisation** – with our high throughput screening platform
- **Recombinant growth factor production** – for animal-free media development
- **Reactor design and optimisation** – using computational fluid dynamics for virtual prototyping

Our facilities supporting cultivated meat products

Animal cell cultures for sustainable meat production

High throughput process screening – using small-scale 15 mL and 250 mL automated microbioreactors and robotic liquid handling platforms to rapidly define optimal cell culture conditions and screen different media

Lab-scale demonstration – Scale-up evaluation and robust mammalian cell culture process optimisation using 2 litre and 10 litre stirred tank reactors and rocker fermenter systems configured for up to 25 litre working volumes

Pilot-scale demonstration – Process scale-up and demonstration using 50 litre and 200 litre stirred tank reactors

Our support for product and process commercialisation

Expertise, equipment and software for supporting key process decisions on design and development

Advanced analytical capabilities

for the production, optimisation and quality control of your products or processes

Computational modelling

for your process design and de-risking your route to commercialisation

Engineering support

for the commercialisation of your product or process

Our capabilities in analytical biotechnology

Production optimisation and quality control through advanced analytics

- **Trace elements and composition analysis** – Basic composition and screening analysis, elemental analysis for food make-up, and organoleptics
- **Production metabolism** – Metabolomics including biomarkers, compound identification, metabolic network modelling, and growth media optimisation
- **Proteins and enzymes** – Sequencing, structural studies and predictions, direct enzyme activity assays, and titre and purity
- **Microbiology** – Viability, microbial identity, and purity analysis

Our facilities supporting analytical biotechnology

Production optimisation and quality control through advanced analytics

Trace elements and composition analysis – using microwave-plasma atomic emission spectroscopy (MP-AES), graphite-furnaces atomic absorption spectroscopy (GF-AAS), elemental analyser, spectrophotometry, FTIR, mass spectrometry, TGA–MS, DSC, and DTA

Production metabolism - HPLC-UV, CAD, mass spectrometry (GC-MS, LC-MS, QToF, and triple quadrupole), and a CEDEX multi-assay system

Proteins and enzymes – Mass spectrometry (GC-MS, QToF, and triple quadrupole), HPLC-SEC, multi-mode plate readers, and SDS PAGE

Animal cell growth and viability – through the use of a Vi-Cell cell counter, confocal microscopy, and FACS

Our capabilities in computational modelling

Process design and de-risking with computational modelling

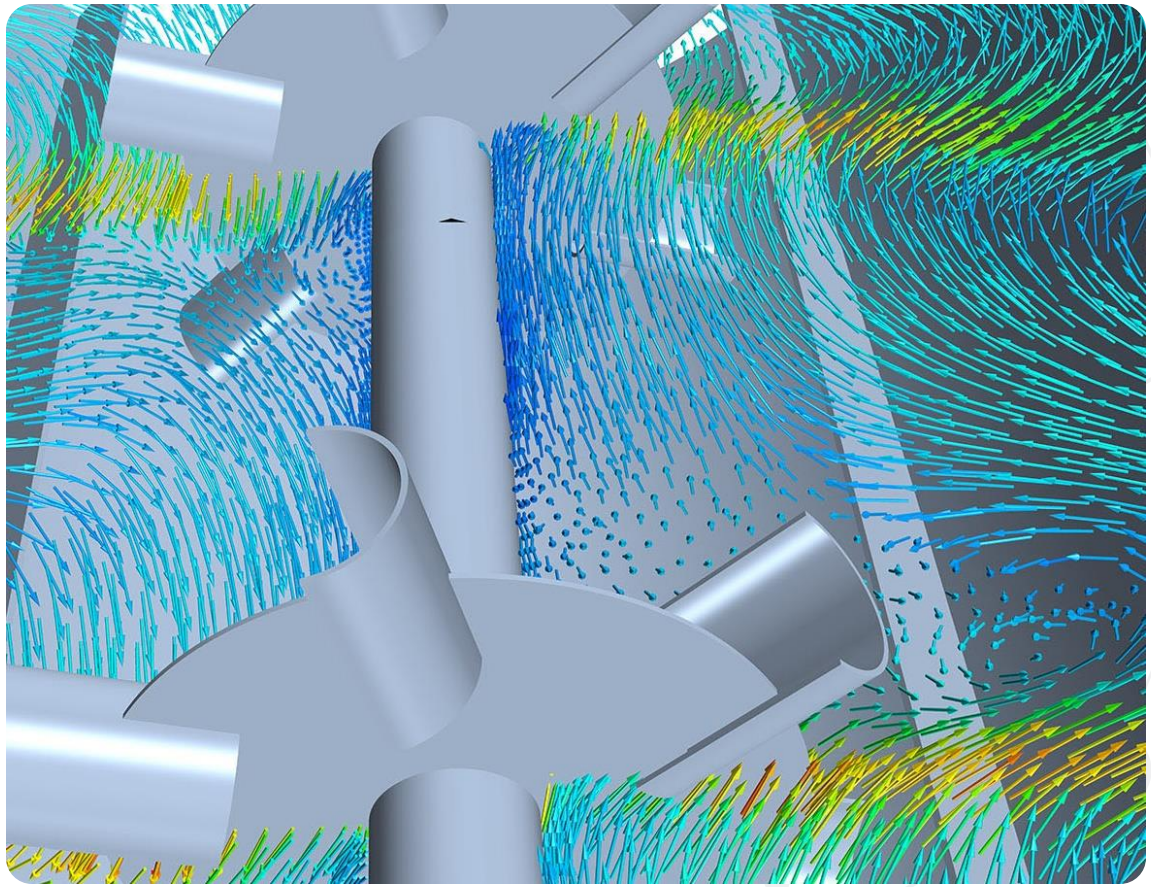
CPI are highly experienced in the application of tools and techniques for multiphysics modelling and simulation to better understand and increase confidence in process design and operational decision making.

Troubleshooting – Identifying the causes of operational issues and finding solutions

Process characterisation and optimisation – Detailed investigation into how we can make existing processes better

Scaling and transfer – Understanding how well a process will transfer between different production equipment and scales, and how to align the process performance between lab and plant

Design, operational guidance, and virtual prototyping – Honest, expert advice on the best options and how to proceed



Our facilities supporting computational modelling

Process design and de-risking with computational modelling

Utilising industry-recognised multiphysics modelling software on high-powered, 64-core workstations, we use CFD and DEM modelling to assess the expected process performance across multiple scales and industries.

Key performance assessment criteria:

- Liquid mixing
- Interphase mass transfer (kLa)
- Gas hold-up
- Bubble break-up and coalescence
- Power input
- Turbulence
- Shear
- Velocity

Our engineering support capabilities

Engineering expertise to support commercialisation

We offer support across a wide variety of areas, covering all aspects of process engineering design, operation and process modelling.

- Concept process design and feasibility studies
- Pilot design, build, and operation
- Hazard study leadership
- Techno-economic analysis
- Process troubleshooting and optimisation
- Engagement and scoping for both vendors and contractors
- Engineer support with EPC management and guidance

Our formulation capabilities in food, feed and drink

We have state-of-the-art facilities for enabling the formulation of complex solids and liquids.

Performance by design

- Quantifying key performance attributes
- Understanding structure and property relationships
- Micro-structural engineering

Advanced process development

- Novel process technologies
- Digitally-enabled pilot scale ‘learning rigs’
- Process scale-up and scale-down

Pack and fill process development

- Digitally-enabled pilot scale ‘learning rigs’
- Process scale-up and scale-down

Our performance by design capabilities

Microstructural engineering expertise to understand structure-property relationships and quantifying key performance attributes, for use in affecting the shelf-life stability, sustainability, health properties, manufacturability and sensory experience of end products.

- **Colloid science**
- **Particle technology**
- **Microencapsulation**
- **Rheology**
- **Characterisation analysis**
- **Robotic and automated high-throughput screening**

Our advanced process development capabilities

Novel process technologies for enabling radical NPD or reformulation, screening of novel process technologies, responsive manufacturing, and for predictive recipe control.

- **Emulsification**
- **Microencapsulation**
- **Baffled reactors**
- **Granulation and extrusion**
- **3D printing**
- **In-process sensor design** for flexible, IoT connected, or cost-effective solutions

Our advanced process development capabilities

Digitally-enabled pilot line

Digitally-enabled pilot scale facilities for enabling radical NPD or reformulation, screening of novel process technologies, responsive manufacturing, and for predictive recipe control.

- **Pilot-scale learning rigs** – Onsite facilities for the extrusion and granulation of complex solids, and stirred tank for uniform liquid environments
- **Sensors** for process and product measurement
- **Process analytics**

Our pack and fill capabilities for process development

Pack and fill for advanced process development

Digitally-enabled learning rigs for process scale-up and scale-down enable variable powder pack and fill, screening of novel process technologies, and responsive manufacturing.

Digitally-enabled learning rigs with powder hopper and powder handling capabilities, sensors for process and product measurement, and process analytics

Process scaling capabilities with our pilot-scale equipment, engineering design services, techno-economic assessments, and computational modelling process predictions

Our capabilities in food, feed, and drink formulation

New route to natural flavours and scents

Development and commercialisation of enzymatic process technologies that yield high value chemical compounds for natural grapefruit flavourings.

Commercial | 2 years

HOW CPI HELPED

Oxford Biotrans approached CPI in 2013 to undertake its development project.

- Facilities
- R&D&I
- Technical knowledge and expertise
- Process validation

PROJECT OUTPUTS

- Development milestone achieved
- New fermentation process developed
- Economic business case refined

OUTCOMES AND IMPACT

- Development milestone
- New product to market
- £4.6m private sector investment secured
- Jobs created and safeguarded

"Our project with CPI was the springboard for our technology commercialisation programme and subsequent market launch. The CPI team were knowledgeable, approachable and responsive and proved invaluable in rapidly overcoming the complex challenges that developing any new process requires."

Jason King
Chief Executive Officer, Oxford Biotrans

Our capabilities in food, feed, and drink formulation

Choc.ly

Edible inks for printing personalised confectionary

Development of edible inks using natural pigments, to improve its resistance to bacterial growth and increase colour stability over time.

Collaborative R&D | 2 months | £6,550

HOW CPI HELPED

- ERDF funding via Project IMPACT
- Expertise in the formulation of printable inks and additive manufacturing
- State-of-the-art facilities

OUTCOMES AND IMPACT

- Formulation of different coloured, natural pigment inks
- Tests conducted on the colour stability and bacterial growth over time of the ink formulations
- Report of findings and recommendations for further research
- Suitable formulations developed for stable inks with reduced bacterial growth
- Greater understanding of the effects of pH changes on bacterial growth
- Further research goals identified
- Discussions with global manufacturers to further commercialise product

"The state-of-the-art facilities and highly skilled teams we had the opportunity to work with through CPI have provided the technical insight needed to advance our natural edible ink formulations [...] and we're now much closer to commercialisation."

Ged Hastie
Technical Director, Choc.ly

Our capabilities in food, feed, and drink formulation

This project has received full or partial funding from the European Union's Horizon 2020 programme

Enabling make-on-demand

The creation of an open innovation digital platform and fablabs for collaborative design and production of personalised fast moving consumer goods.

Collaborative R&D | 36 months | £6.8 million

HOW CPI HELPED

- European Union funding through the Horizon 2020 programme
- State-of-the-art facilities

CPI brought together a consortium of 13 partners to address key barriers to on-demand FMCG. Led by SINTEF, The project has received input from Procter & Gamble, a global leader in the FMCG industry, with CPI and the UK's Digital Catapult providing the technical lead.

OUTCOMES AND IMPACT

- Enabling higher premium products, service models
- Dramatically reduced waste and environmental impact

"With this strong consortium of partners, the DIY4U project offers a new consumer-centric model of FMCG design and manufacture that will catalyse the positive disruption the sector is seeking."

Graeme Cruickshank
Chief Technology and Innovation Officer, CPI

Adding value to innovative companies

Cross-sector expertise, networks and technologies

Additional resources and ready-to-use capabilities

Multi-disciplinary team with a focus on **novel solutions for Innovation**

Techno-economic reviews and assessments to find new **market opportunities**

Exploring the established facts with new technologies and approaches

New product development from lab to production

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Working together with CPI

Here to help your business

Knowledgeable support, resources and facilities

Raise investor confidence by **generating robust data**

Access our comprehensive **network of investors**

Flexible project **resources** and **service options**

Reduce risk and decrease your time to profitability

Connect with the wider **supply and value chains**

Support in navigating the complex **grant funding landscape**

Let's innovate together
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Fee for service

- **One-to-one** project with CPI
- **Flexible scope** and project size
- **Rapid initiation** of projects
- Can encompass a range of services including business and innovation support, consultancy, and lab-based projects

Offers flexibility and speed

Collaborative projects

- **One-to-one** with CPI or together with a **larger consortium**
- Projects initiate after completion of a **detailed funding protocol**
- We offer a bespoke service for **bid development** and **grant landscape navigation**

Best option for highly innovative projects you can't fully fund yourself

Funded SME support

- Smaller projects may qualify for **total funding** status from ERDF programmes
- **Regional limitations** can apply to supporting SMEs

Great mechanism for an initial engagement with us

Here to help your company

Demonstration of **disruptive** and **market-creating** technologies

Industry level input on policy-making for local and national innovation strategies

Driving capital efficiencies with access to over £170m of innovation assets

Driving **industry-level standards** with pre-competitive collaboration

Cross-industry knowledge that drives horizontal innovation and accelerates commercialisation

Reduce risk and decrease your time to profitability

Support in navigating the complex **grant funding landscape**

Access **innovative start-ups** developing the technologies of tomorrow

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Best option for highly innovative projects you can't fund fully yourself

Here to support academia

Support for spin-outs
helping you to generate revenue faster

Create impact faster
with rapid analysis, scale-up, and proof of concept

Diversify funding sources
with flexible development of winning bid propositions

Infrastructure funding
leveraged to maintain leading scientific capabilities

Competitive research council propositions
through pledges of support in submissions

Develop your people
with an enriching experience working in a Catapult centre environment

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Thank you

For more information visit **www.uk-cpi.com**

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