Enzymatic Extraction of High-value Ingredients from Food Waste

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FOOD WASTE FACTS

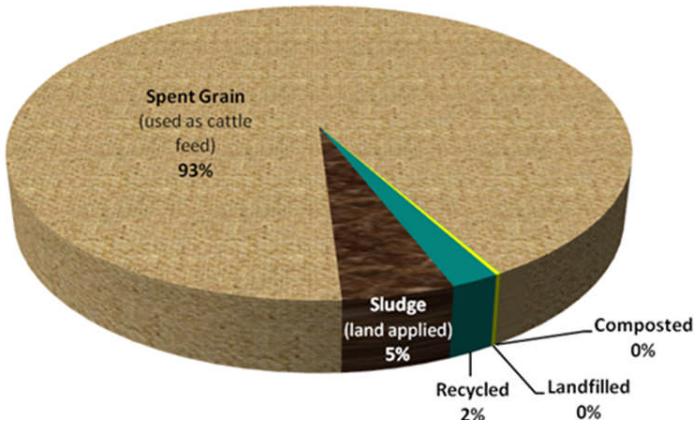
- Food waste: concerns from an economical, environmental and food security perspectives.
- Over 1 million tonnes of food waste produced annually in Ireland.
- 89 million tonnes food waste produced annually throughout the Europe.
- Roughly, 1.3 billion tonnes food per annum is being wasted.

- Common utilization of food waste:
  - incorporation in animal feed
  - direct disposal in landfills

REGULATIONS

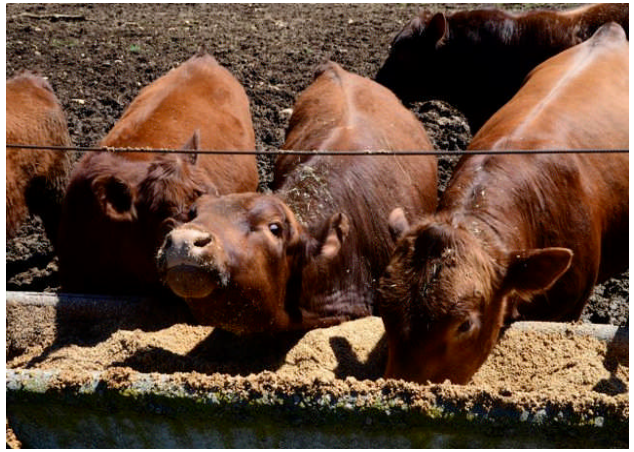
- Government pressure on food industry to reduce the food waste.
- The management of food wastes is becoming extremely difficult due to legislative restrictions on landfill.
- In Europe, policies are created to promote the prevention of food waste in all the life stages:
  - Integrated product policy (EC, 2003)
  - Resource efficiency flagship initiative (EC, 2011) and
  - the bio-economy communication (EC, 2012)

FOOD WASTE INTO ANIMAL FEED



- Some of the food waste is used as animal feed.
- Spent grain: up to 93% used as animal feed.

- Some of the food waste is not very ideal for animal feed.
  - Low in protein content
  - High in lignin content (olive waste)
  - High in potassium (potato) (only suitable for cattle feed)



ADDING VALUE TO FOOD WASTE

- Offer a range of potentially useful alternatives for dealing with food waste other than disposal and/or landfilling.
- Basic valorisation strategies including composting, recycling and burning are able to recover/convert less than 50% of the waste into useful products.
- Novel strategies: physical, biological and enzymatic technologies
- These include (but are not restricted to):
  - Ultrasound-assisted extraction of useful components
  - Biological (e.g. fermentation) and
  - Enzymatic approaches for the isolation of valuable components

WHAT HIGH ADDED-VALUE COMPONENTS??

- Lead to possibilities for the production of valuable products with a market value.
- These include:
  - Enzymes (Amylase, Protease etc.)
  - Nutraceuticals
  - Functional foods
  - Food preservatives (Polyphenols)
  - Organic acids (Lactic acids etc)
  - Food additives
  - Pharmaceutical products

ONGOING RESEARCH IN OUR LAB

- Our goal is to obtain products of high added value from food waste.
- Most appropriate treatments and technologies from the environment friendly and cost-effective standpoints.
- In pursuit of waste recovery as a better alternative to waste disposal our research is focused on:
  - Biochemical characterization of waste and industrial by-products.
  - Enzymatic and microbial techniques for extraction of high added-value components.
  - Purification and characterization of high added-value components.
  - Functional characterization.
  - Cytotoxicity analysis

β- GLUCAN FROM BREWER'S SPENT GRAIN

- Brewer's spent grain: main waste product from beer production (85%)
- 20 kg per 100 litres beer produced
- 160,000 tonnes Brewer's spent grain produced in Ireland annually
- Rich in fibre, protein, carbohydrate and phenolic compounds
- High availability, low cost and proven safety for human consumption.
- Applications:
  - β-glucans are the only dietary fiber recognized by the EFSA to be able to reduce a disease risk and also used to boost the immune system.
  - Food supplement and as an ingredient in product formulation.
  - Non-caloric thickening and stabilizing agents.

CHITIN FROM MUSHROOM'S WASTE

- About 55,000 tonnes of mushrooms produced in Ireland annually.
- Waste ranges between 5 and 20% of production volume.
- Mushroom waste generally used as compost.
- Due to its physical and chemical properties, chitin is being used in different products and applications:
  - Emulsifiers, thickening, and gelling agent for stabilizing foods
  - Used as a dietary fibre in baked foods
  - Paper and textile industry
  - Cosmetics and biomedical industry

GLYCOALKALOIDS FROM POTATO PEEL

- Potato production in 2010 was more than 450,000 tonnes in Ireland.
- Industrial processing of potatoes generates large quantities of peel that create disposal, sanitation, and environmental problems.
- The potato peels are rich in glycoalkaloids such as α-solanine and α-chaconine, carbohydrates, high in starch (8-28%) and about 1-4% protein.
- Has strong inhibitory effects on fungal and insect pests and can be exploited as natural pesticides.
- Medicinal properties

PROBIOTIC BEVERAGES

- Development of probiotic beverages based on Bewer's spent grain as substrate
- Supported prolific growth of *L. brevis*, *L. plantarum* and *L. rhamnosus* up to 10.4 log cfu/ml
- Production of 2.95 g/l lactic acid
- Release of 268.6 mg gallic acid equivalent of phenolic compounds
- Rich in antioxidant properties
- Shelf stable in terms of bioactive components and probiotic counts for 15 days

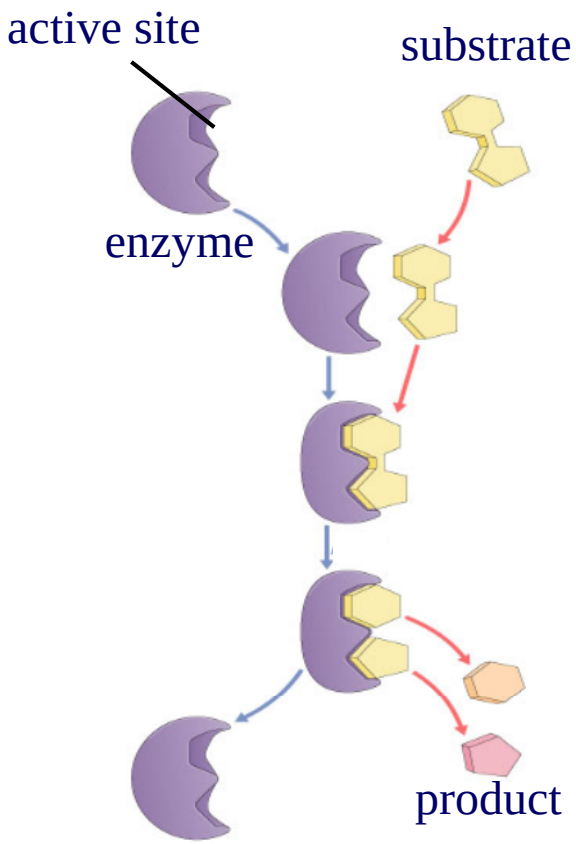
TRADITIONAL EXTRACTION APPROACH

- To date, most of the extraction procedures are solvent based.
- Solvent has negative impact on cost and environment.
- Possible solvent contamination of the final products leads to the health and safety issues.
- Focus moved to the safe technology which uses very small or no organic solvent.

BIOLOGICAL EXTRACTION

- Eco-friendly extraction technologies
- Faster extraction
- Higher recovery
- Reduced solvent usage
- Lower energy consumption and

ENZYME-ASSISTED EXTRACTION…



Enzyme-assisted extraction

- Highly specific and versatile
- Enzymes are not changed by the reaction
- Re-used again for the same reaction with other molecules
- Very little enzyme needed to help in many reactions
- Used only temporarily
- Relatively cheaper than organic solvents

Thank You

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