Sustainable Bioenergy Solutions for Tomorrow

VALORIZATION OF NON-WOOD BIOMASS – CASE STUDIES WITH FOOD INDUSTRY SIDE-STREAMS AND MUNICIPAL FOOD WASTE

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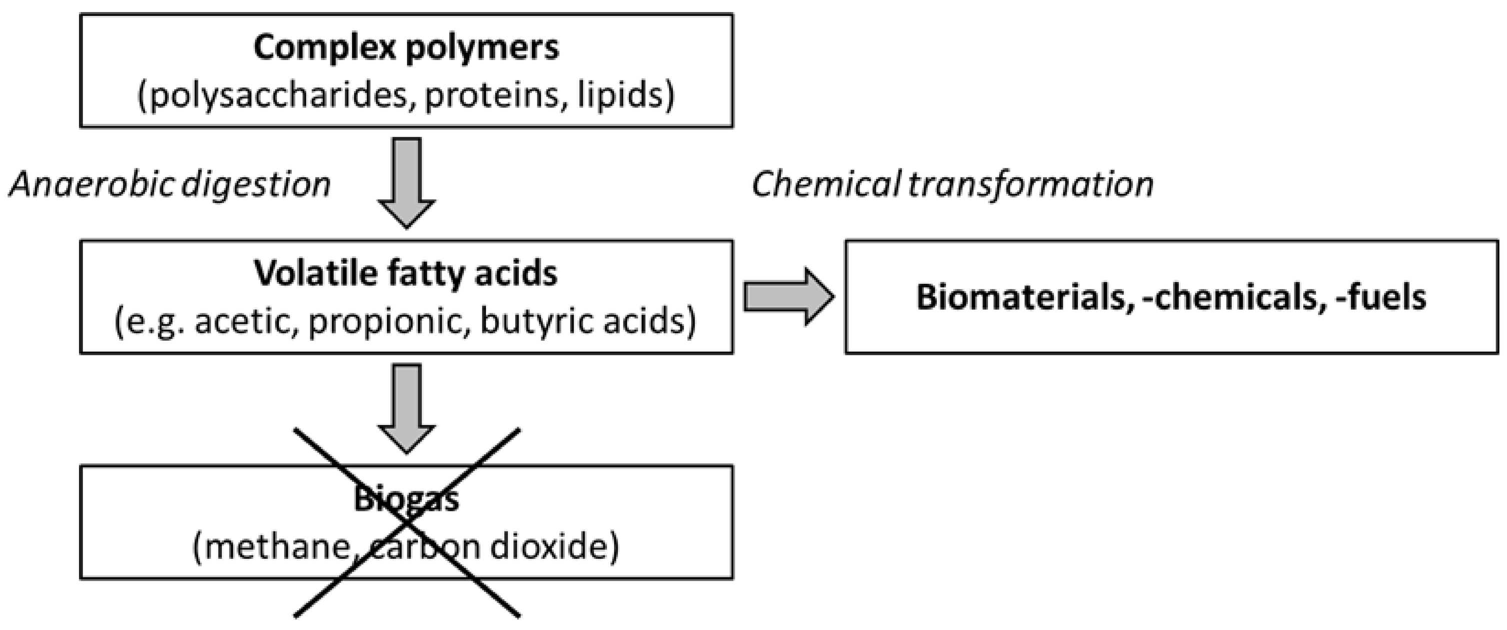
VFA PRODUCTION

Anaerobic digestion (AD) is a flexible microbial process, which can be modified to produce different energy carriers, e.g. methane (CH_4), hydrogen (H_2) and volatile fatty acids (VFAs) from waste biomass, such as food industry side-streams and municipal food waste. VFAs are short-chain fatty acids, i.e. fatty acids from C2 to C6 (acetic, propionic, butyric, etc.). The resource- and cost-effective production of VFAs from waste materials has become an interesting option for the production of biochemicals, -materials and -fuels.

<u>Production of VFAs instead of biogas through anaerobic digestion:</u>



One promising application is the production of polyhydroxyalkanoates (PHA). PHAs have properties comparable to petrochemical plastics and they can be used in injection moulded products, foams, films and coatings. In addition, PHAs are completely biodegradable, which means that the accumulation of plastics in the nature could be avoided by using PHAs instead of petrochemical plastics.

<u>Applications of VFAs:</u>

Use	Application
VFAs used as such	• acidifiers in foods and beverages • additional carbon source for biological nutrient removal in municipal waste water treatment
Building blocks for chemical transformation	• several organic compounds, e.g. alcohols, aldehydes, ketones, esters and olefins
Substrates for microbial production	• polyhydroxyalkanoates (PHA) production • biodiesel production through synthesis of single cell oils (SCO) by oleaginous yeast • production of hydrogen via photo-fermentation by mixed microbial cultures • microbial fuel cells

PROCESSING OF VEGETABLE BY-PRODUCT

Largest amounts of food waste are usually produced within the production chains of fresh fruit, vegetables and bakery products. Particularly fruit and vegetable wastes are highly perishable. For better utilization as food, feed or further processing, conservation of these materials is needed. Most common conservation methods are fermentation and drying. During fermentation pH is reduced and thus growth of harmful microbes is inhibited.

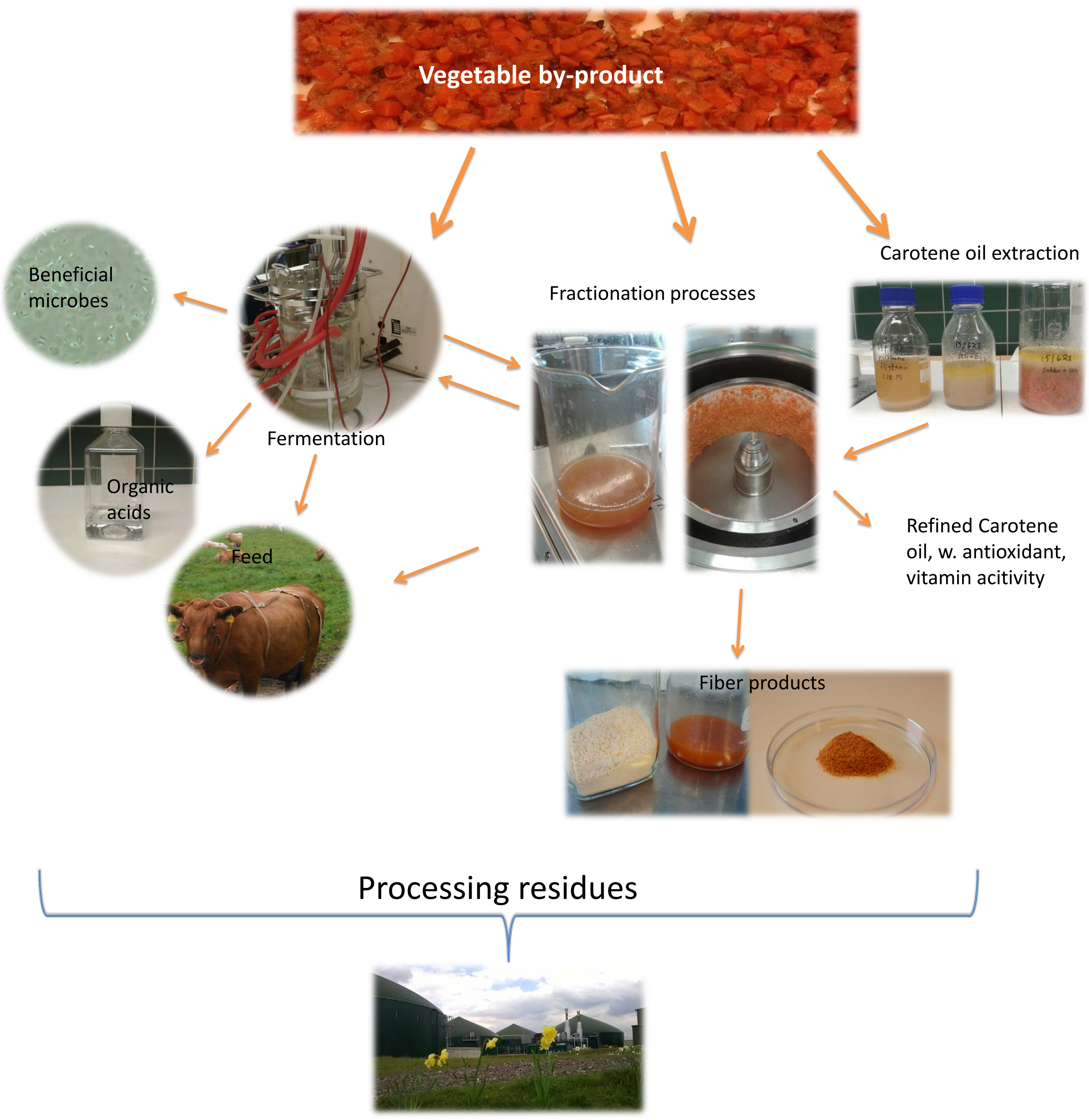
Food industry side-streams can be used as raw materials for production of many commercial compounds. Currently, building block chemicals, such as lactic acid, succinic acid, glycerol, sorbitol, 3-hydroxypropionic acid, and isosorbide are produced from renewable raw materials.

Example of processing options of a vegetable-based biomass is shown below in the figure. Use of food industry side-stream as raw material is combined with an energy-efficient production system. When lactic acid bacteria are utilized, the process can yield beneficial bacteria, organic acids and/or feed material. Fractionation can be conducted before or after fermentation.

Fractionation by centrifugation or pressing removes water or oil with dissolved valuable compounds. Excess water removal has also benefits before long-distance transportation. Bulk fractions, especially after fermentation can be used as such as feed. More specific separation processes are needed for purification of natural or by fermentation produced biomolecules for pharma, food, or special feed ingredient use.

Removal of valuable compounds improves the overall feasibility of the process, but does not usually remarkably reduce organic content of bulk. The process residues can be used for biogas production after more valuable materials are extracted.

<u>Processing options and possible end-products:</u>



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