

## CORNET BYPROVAL Project

# Waste to Wealth

The **BYPROVAL** joint research project currently being undertaken by PFI Biotechnology and the Belgian research institute Celabor examines the extraction of valuable constituents of three selected residual products from fruit and vegetable cultivation or processing. The main focus is on the residues from pea processing (stalks, leaves, pods), apple pomace, and carrots, which are rich in valuable secondary plant products. The goal of the project is to provide an added value chain for existing biogas plants through a combination of extraction and biogas production.



Year for year in Germany, huge amounts of residual products from fruit and vegetable processing are used as animal feed, fertiliser, or substrate for biogas plants. Many of these residues also contain valuable plant products. It is therefore worthwhile to isolate these products for marketing before conventional utilisation of the residues. In the BYPROVAL project, the residues from pea processing (stalks, leaves, pods), apple pomace, and carrots were selected for further investigation in a first step from among numerous possible candidates on the basis of various assessment criteria such as price, availability, content of valuable secondary plant products, and biogas potential (Tab. 1). Moreover, these residues also contain valuable plant constituents with health-promoting properties. These substances should be extracted for marketing prior to energetic utilisation of the residues. Extraction is expected to have a negligible influence on the fermentability since the actual energy sources, i.e. cellulose, starch, and proteins, are not removed from the plant material.

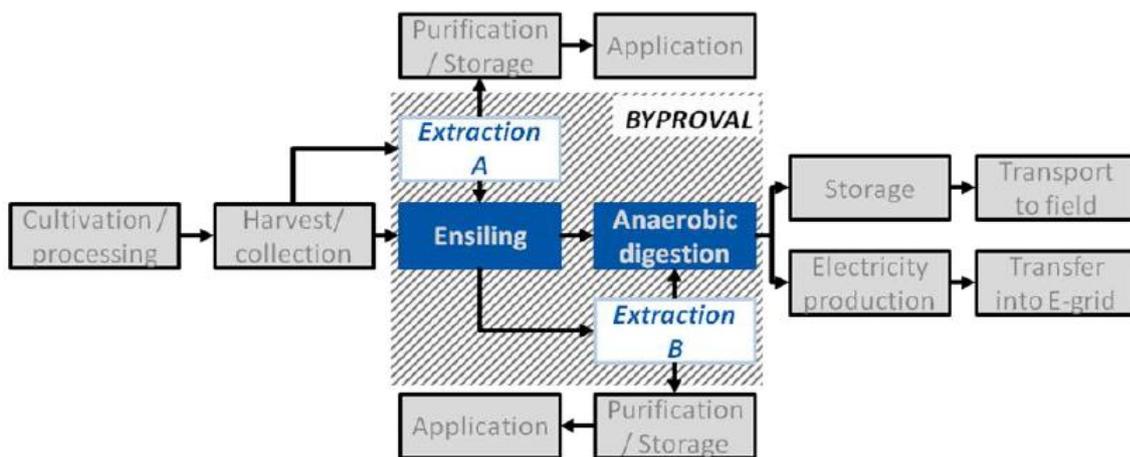
	Pea processing residues	Apple pomace	Carrots
Secondary plant substances	Phytic acid, carotenoids, polyphenols, chlorophyll	Catechin, chlorogenic acid, phlorizin, quercetin, quercitrin, epicatechin	β-Carotene
Dry matter [%]	26	16	10.6
Biogas potential [NI/kg ODM]	512	500 – 600	630
Price [€/ton]*	18	0	0 – 2.5
Annual availability at selected location [tonnes]	1260	1360	3300 – 4358

*\*Depending on region and location*

**Table 1: Selection criteria for further investigation**

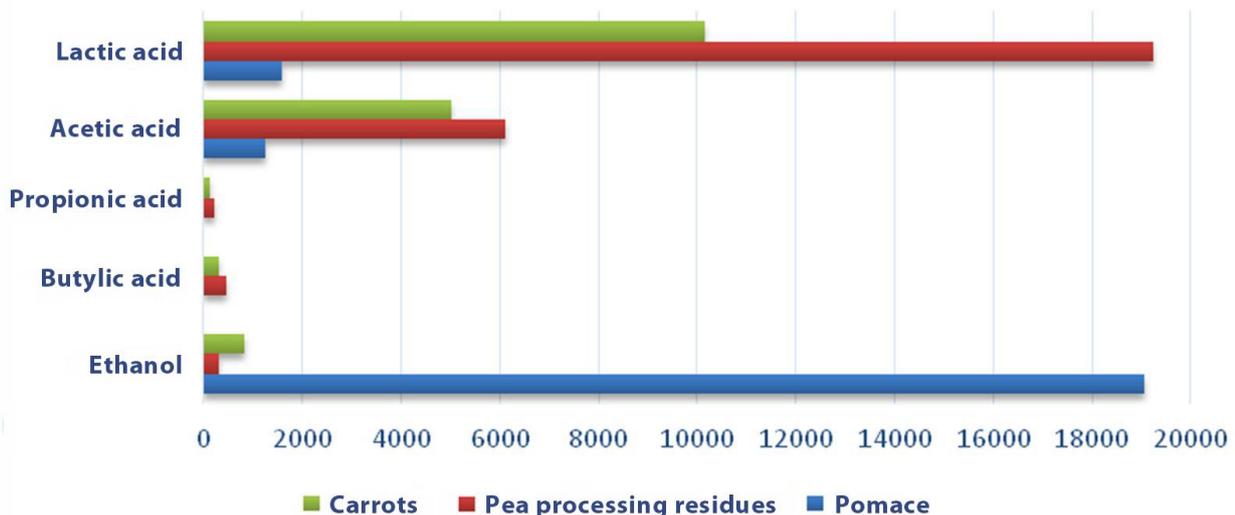
**Extraction Before or After Ensilage?**

With regard to the value chain as depicted in Fig. 1 it was important to establish which is the more effective extraction strategy: before or after preservation by ensilage. Ensilage is the standard method for preservation of substrates in the biogas sector. On compaction in a silage clamp with exclusion of oxygen fermentation processes take place with naturally occurring organisms which lead to acidification and hence preservation of the material, as in the case of sauerkraut. The process can be accelerated by use of silage additives. As a rule, these are mainly lactic acid bacteria cultures; in high concentration they boost conversion of the fermentable substances.



**Fig. 1: Positioning of BYPROVAL in the value chain of an agricultural biogas plant. Extraction A and Extraction B refer to the two available options, extraction before or after ensilage.**

It turned out that all three substrates can be ensilaged. Fig. 2 shows the degree of acidification after ensilage. The dominance of lactic acid fermentation is clearly to be seen in the case of pea processing waste and carrots. In contrast, alcoholic fermentation predominates in the case of apple pomace.



**Fig. 2: Acid and alcohol concentrations (mg/kg) in the substrates after ensilage**

All three residual materials gave satisfactory results with respect to conservation. It remains to determine the influence of ensilage on the concentration of the valuable plant products. Preliminary results suggest that these substances undergo degradation during ensilage. If this should prove to be the case for all substrates, it will be necessary to adopt the alternative strategy of extraction prior to ensilage. The influence of extraction on ensilage and the consequences for substrate handling will become apparent by the end of the project.

### **Practical Implementation**

A case study performed in conjunction with the project will ensure faster implementation of the results. The BGA Friedrich biogas plant operated by the company Theo & Ingrid & Alexander Friedrich GbR in the Palatinate vegetable growing region of Germany will serve for theoretical consideration of the use of an extraction unit on the site of a biogas plant. All relevant plant data have already been recorded. The plant is in the immediate vicinity of areas used to grow vegetable. Up to 40,000 tonnes per annum can be produced within a radius of 12 km (Tab. 2). On the basis of laboratory results from Celabor and PFI, an extraction unit is being designed for integration into the biogas system of BGA Friedrich. The thermal energy necessary for the extraction process is to be supplied by the CHP plant, thus minimising energy consumption. The EU Fertilisers Regulation foresees hygienisation of fertilising products produced from waste materials. This requirement should be fulfilled by extraction with an extraction unit designed to provide the temperatures and residence times necessary to ensure hygienisation.

**Table 2: Characteristic data of BGA Friedrich**

Input material	90 % maize, 10 % grass
Feed rate [t/d]	32
Feedstock supply area [ha]	230
Feedstock supply radius [km]	12
Fermenters [m <sup>3</sup> ]	2 x 950
Silage clamps [m <sup>3</sup> ]	2 x 910, 1920
CHP [kW <sub>el</sub> ]	250, 340
<i>Future option:</i>	
Vegetable processing waste (carrots, potatoes, leeks, etc.)	40,000 t/a
Availability of substrates	June to November

The project is being conducted in cooperation with the Belgian Celabor Research Institute. [Celabor](#), based in the Walloon Region of Belgium, is a scientific and technical services centre in the Petit-Rechain industrial park located in the vicinity of Verviers. The institute offers scientific and technical support for companies in the agri-food, environmental, packaging, paper, and textiles sectors.

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**BYPROVAL project info**

**Title: New Valorization Pathway for Fruit/ Vegetable Waste by a Combination of Extraction and Biogas Production**

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**Project partner:**



**Funding bodies:**



Gefördert durch:

