Development of New Competitive and Sustainable Bio-Based Plastics

Feedstock characterization for PHB production

The overall aim of NEWPACK is the sustainable production of bio-plastics films based on PHB-PLA blends for food packaging obtained from residual agri-food biomass. While commercial PLA will be used, PHB will be obtained through a specific fermentation process using as substrate hydrolysates obtained from residual agri-food biomass: potato peels and sweet corn residues.

These residues were selected for several reasons, like the significant production as by-products of other processes (e.g. from 70 to 140 thousand tons of potato peels worldwide annually) and their sugar availability for easy digestion to facilitate the fermentation.

However, vegetable by-products have a high moisture content (around 89%) and, due to seasonality, they have the disadvantage for appropriate provisioning and storage. Therefore, in the project activities, different pre-treatment technologies have been applied to store and distribute the by-products in a stable condition (**Figure 1**).

Due to the special characteristics of sweet corn by-products, the pre-treatment starts with an initial cutting process to reduce particle size to approximately 25*25 mm using an industrial rotary mincer.

Secondly, due to the by-products characteristics and taking into account their fast degradation, it is necessary to apply a drying operation to reduce (up to 12%) the initial moisture content using an industrial dryer or a drum dryer for sweet corn or potato peels respectively.

Finally, a milling operation is necessary to reduce the particle size to around 15*15 mm to improve later hydrolysis operation. After studying various milling equipment for vegetable by-products, it was decided to choose a hammer mill. This mill is easy to clean and operate and also its screens can be changed and can operate in a closed system reducing the risk of explosion and cross contamination.

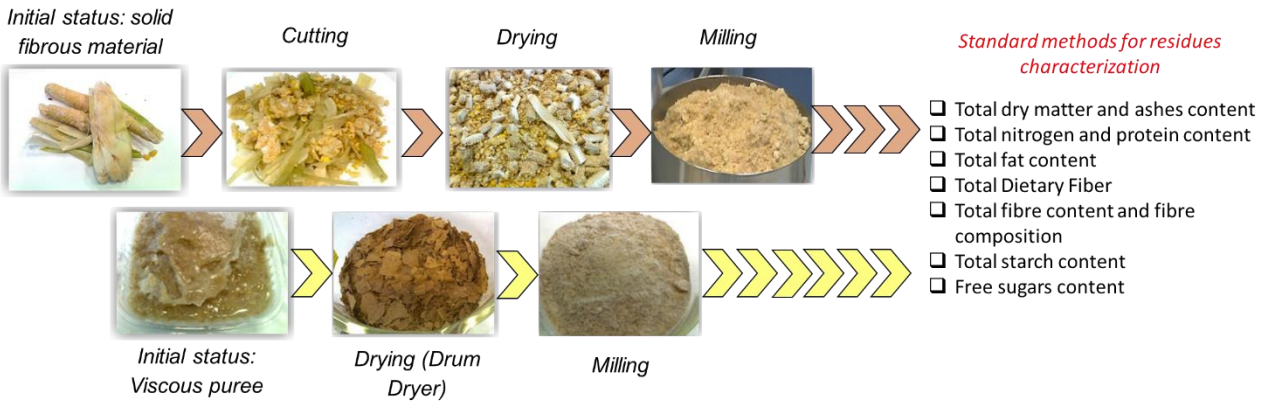

Figure 1: Sweet corn and potato peels pretreatment & standard method for their characterization in the NewPack project

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In addition, the proper characterization of the residues is essential to be able to define the necessary processing steps for their pre-treatment and subsequent high-yield conversion to PHB.

Fermenting microorganisms basically need suitable carbon and nitrogen sources in the substrate, plus other micronutrients that can be, anyway, additionally supplemented in the fermentation process. Therefore, the total nitrogen and carbohydrate content and profile are the main parameters to be analysed and controlled.

Total fat is another important parameter that, if too high, can be a negative factor for fermentation. Therefore, physical and chemical composition of milled sweet corn and potato peels have been determined applying a set of appropriate standard methods (**Figure 1**).

The obtained compositions (**Figure 2**) were found in agreement with literature data. These data will have to be used in combination with the sugar concentration obtained through by-products hydrolysis to assess the efficiency of the applied process and the feasibility of exploiting such by-products for PHB production.

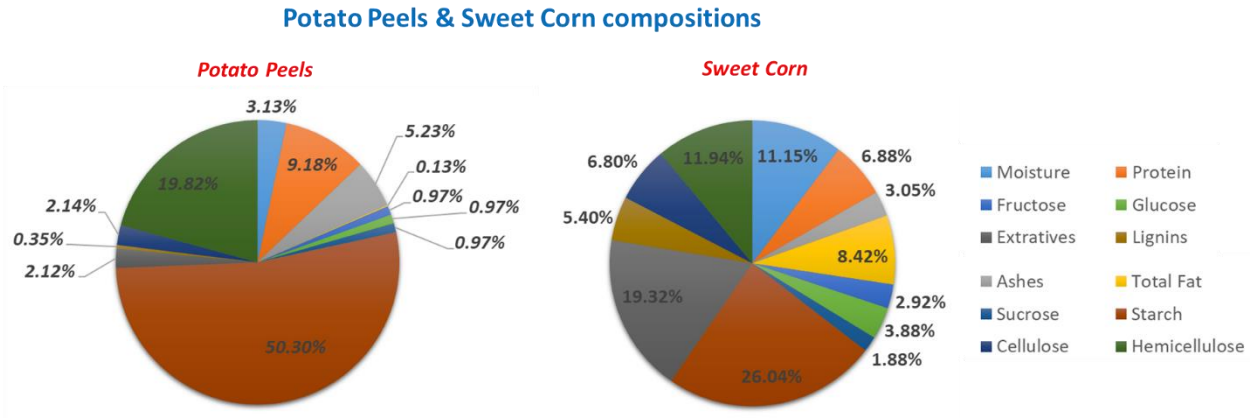

Figure 2: Potato peels and sweet corn composition (% w/w) collected and analyzed in the NewPack project

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