Starch from Oil Palm Trunks for Food and Non-food Applications to Reduce Oil Palm Footprint

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EUBCE 31st European Biomass Conference & Exhibition

Introduction & Objective

Oil palm trees need to be replanted when productivity reduces at 20 to 30 years after planting. Generally, the old trees are chopped and left in the field to decay. However, it is estimated that the oil palm trunks (OPT) contain 2 to 6 ton of starch per hectare. Roughly 60% of the starch is located in the top 1/3 of the trunk. Extraction and using the starch from OPT for biobased and food applications will result in land sparing and will reduce the footprint of oil palm.

The objective of this study was to experimentally determine the starch and glucose content of OPT top samples. In addition starch and glucose were extracted and purified to determine its properties in order to determine its potential applications.

Experimental work

Figure 1. Obtaining oil palm trunk top samples in Malaysia.

OPT top samples were obtained in Malaysia in cooperation with Profina Plywood, a company that uses the lower part of the trunk for veneer production. Analysis and starch extraction was performed at Wageningen Food & Biobased Research in the Netherlands.

Starch was extracted using a procedure that included shredding, soaking in a sodium metabisulphite solution, sieving, sedimentation, multiple washing steps, and finally freeze-drying. HPLC analysis was performed to determine the starch and glucose content of the samples and extracts.

Figure 2. Shredded oil palm trunk.

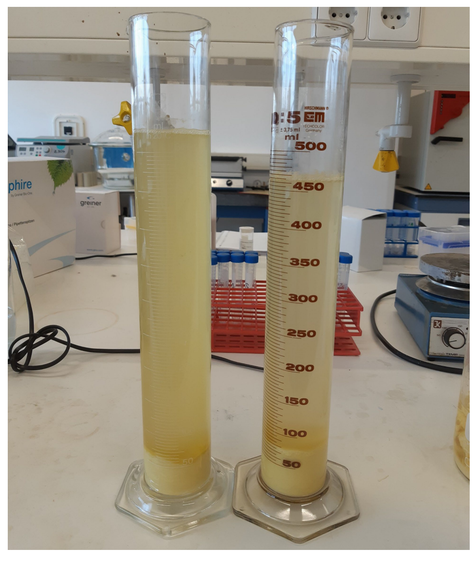

Figure 3. Sedimentation of starch from soaked oil palm trunk filtrate.

Results

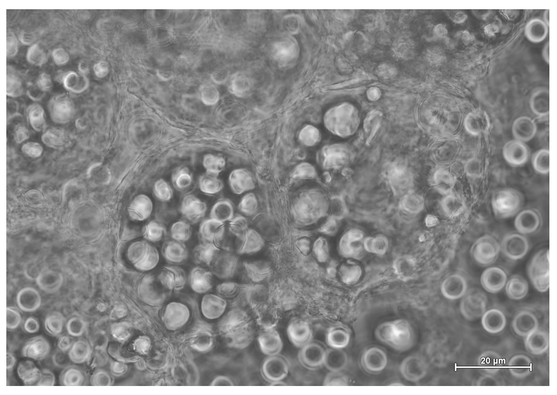

Figure 4. Light microscopy image of washed oil palm trunk starch sediment with partially intact parenchyma cells containing (trapped) starch granules.

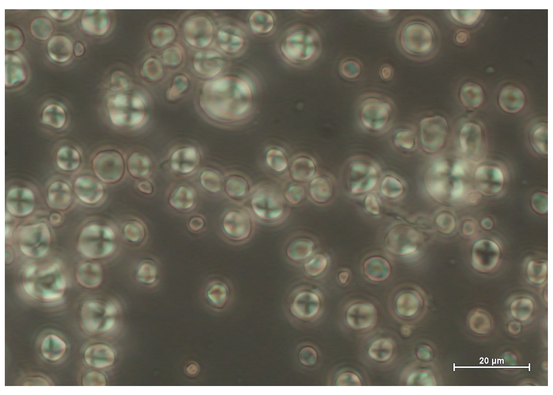

Figure 5. Light microscopy image using polarized light of purified oil palm trunk starch granules. The Maltezer crosses indicate crystalline (native) starch.

The analyses showed a significant variation in dry weight, starch content and glucose content among OPT and even within a single trunk. The minimum and maximum contents of the samples were:

- Dry weight: 18% - 33%
- Starch: 17% - 46%
- Di- and oligosaccharides: 0.6% - 3.6%
- Glucose: 1.6% - 8.6%

The extracted and purified OPT starch had a purity of 67%. Light microscopy showed Malteser crosses, indicating crystalline (native) starch. The size range of the starch granules was between 5 to 15 µm. The pasting behaviour of the obtained OPT starch was determined with a rapid visco-analyser (RVA). Despite the relatively low purity, an acceptable pasting behaviour was shown. It is presumed that the yield, purity, and functionality of the OPT starch can significantly be improved in an optimized process using industrial scale equipment.

Future work

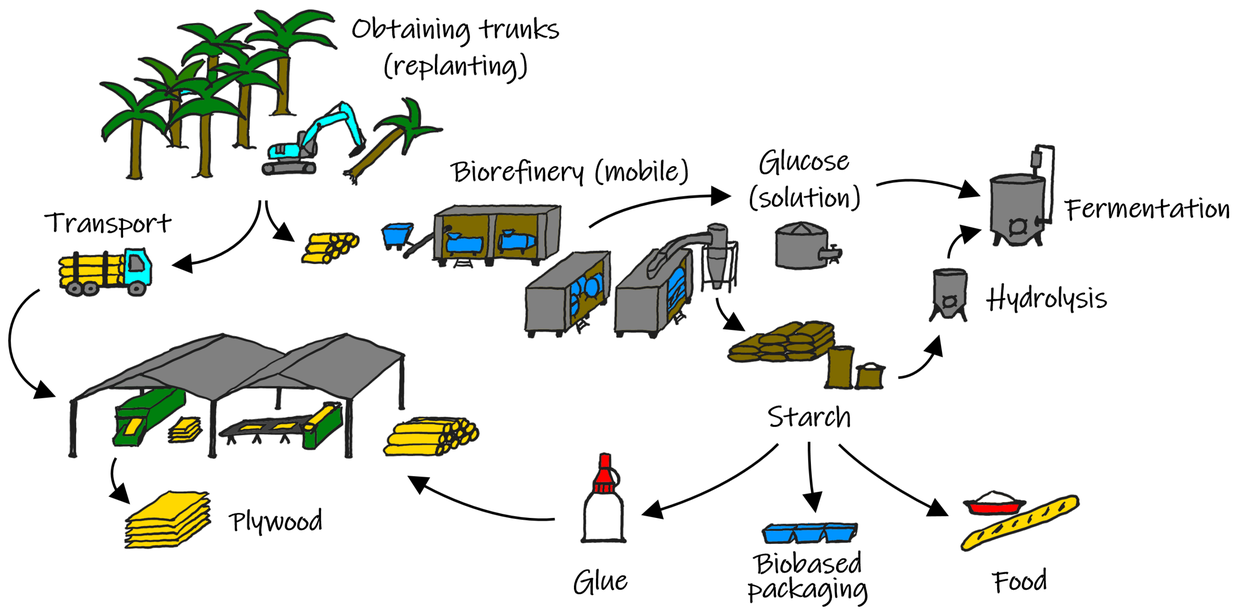

Figure 6. The foreseen valorisation chain of starch and glucose from oil palm trunks using a mobile starch extraction factory.

The results of the experimental work will be used as a start for a new research project to develop a mobile starch extraction factory and applications for starch and glucose. Foreseen are glues, bioplastics, food ingredients, and fermentation products. Considering that in the coming decades Malaysia and Indonesia will have to replant roughly 800.000 ha oil palm per year, the estimated potential of available OPT starch could be more than 2 million ton per year. If this OPT starch would replace cassava starch, the permanent land sparing would be more than 700.000 ha.

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Acknowledgements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731101 (BRISK2) and LWV22258 PalmStarch (BO-69-001-008)