CAPCOM-NL

D1: Biomass Sourcing

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We thank our partners Palmaceites (Col.), Raizen (Braz.), and Cradle Crops (NL) for delivery of the raw materials used in the research.

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Contents

1 Introduction

This document is a deliverable of the CAPCOM-NL project. It presents the biomass preparation and characterization of the biomass starting materials. The biomass sourcing is reported in Chapter 2. Chapter 3 describes the preparation of raw biomass for testing in the rest of the project (T1.4). The resulting samples were characterized by SGS and Eurofins (Chapter 4) (T1.1, T1.2 and T1.3).

2 Biomass sourcing

For the CAPCOM-NL project, biomass was sourced from three resources: Oil palm mill (paragraph 2.1), Sugar mill (paragraph 2.2) and Miscanthus (paragraph 2.3).

2.1 Palm oil mill residues

Palm oil mill residues were collected at Aceites Palm Oil Mill in Colombia near the city of Fundación. All residues were dried and stored in big bags. The big bags were transported to the Netherlands. The following residues were used in this project:

- Empty Fruit Bunch (EFB): The fruits are harvested as Full Fruit Bunch (FFB). The FFB is transported to the palm oil mill. In the palm oil mill, the FFB is sterilized and then the fruits are separated. The EFB is left over.
- Mesocarp Fibres (MF): The fruits that were separated from the FFB are treated in a digester and oil is pressed out. The fruit fiber (Mesocarp Fibre) is left over.

The data collected on average palm oil mill size and mass flows are presented in D3.

2.2 Sugar mill residues

Sugar mill residues were collected by Raizen in one of their sugar mills in Brasil (Sao Paulo region). All residues were dried and stored in big bags. The big bags were transported to the Netherlands. The following residues were used in this project:

- Sugar cane bagasse (SCB): Inside the sugar mill, the sugar cane stalks are crushed. The sugar is extracted in a multi-stage counter current extractor. Sugar cane bagasse is left over.
- Sugar cane trash (SCT): Sugar cane trash contains the leaves of the sugar cane. In the fields these residues lead to problems when left in the field (reduced sugar yields, insect plagues, etc.). The trash can be collected with the stalks (separation will be done in the sugar mill), or as a separate stream.

The data collected on average sugar mill size and mass flows are presented in D3.

2.3 *Miscanthus*

Miscanthus was harvested, chopped and dried by Cradle Crops. It was packed in plastic bales. Counter Current extraction of *Miscanthus* proved to be more difficult than extraction of other materials (SCT and EFB). Also, the price of *Miscanthus* is much higher than the price of SCT and EFB. Therefore, it was decided to focus on the other residues and *Miscanthus* was not sent to SGS for detailed analysis.

3 Biomass preparation

Biomass preparation is needed to increase the specific surface of the biomass to enhance extraction. At smaller scale, also the size of the particles should be sufficiently small to allow efficient filling of the columns and to prevent wall effects. Usually the packing is a bit more loose near the wall, as the wall is a straight and rigid surface and will not fill the voids in between particles. In chromatography, it is generally stated that the packing particle diameter should be 10 times smaller than the column diameter to keep wall effects negligible. Our materials are not spherical and rigid, but mostly fibrous. As a fibre, it has two dimensions (length and diameter). Generally the diameter is small (less than 1 mm) and the length is determined by the biomass preparation method (milling, chopping). Due to the fluffiness, voids will be filled more easily. Therefore, it is assumed that fibre lengths larger than one tenth of the column diameter will not be detrimental.

Several preparation methods were tested.

1. Shredder
2. Hammer mill
3. Cutter
4. Cutting mill

1. Shredder: Biomass is torn apart by roller with sharp pins

Figure 1 Shredder with pressed EFB

2. Hammer mill: Hammers turn around in a cage, where the biomass is fed. For EFB, no sieve was used, in the other experiments a 10 mm sieve was used.

Figure 2 Hammer mill with pressed EFB in foreground

3. Cutter: The material is spread on a conveyer belt. The material is slowly moved to the end of the belt where it is cut with a knife. The conveyer belt speed was adjusted to its minimum speed, resulting in a 6.25 mm cutting distance.

Figure 3 ***Cutter***

4. Cutting mill: Knifes run around in a cage where the biomass is fed. An 8 mm or 2 mm sieve was applied.

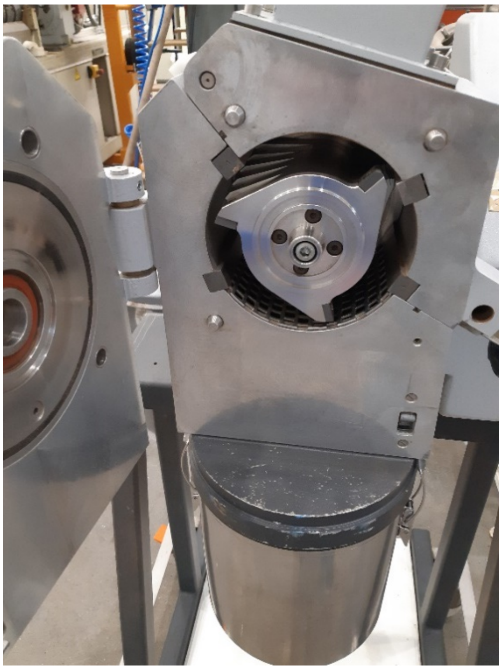

Figure 4 ***Retsch cutting mill***

Table 1 ***List of biomass used in experiments***

Abbreviation	Biomass description	Origin
EFB	Empty Fruit Bunch	Colombia
MCF	Mesocarp Fibre	Colombia
Mis	Miscanthus	Netherlands
SCB	Sugar Cane Bagasse	Brazil
SCT	Sugar Cane Trash	Brazil

Table 2 ***Overview of Biomass preparations***

Material	Treatment	Origin	Label
EFB	Screw pressed and dried at POM	POM	ACE 0001
EFB	Shredded	ACE 0001	FBR 0024
EFB	Shredded, Hammer Milled	ACE 0001	FBR 0025
EFB	Shredded, Hammer Mill, Cutted 6.25 mm 2x	ACE 0001	FBR 0008
MCF	Dried	POM	ACE 0002
MCF	Untreated	ACE 0002	FBR 0002
Mis	Harvested and dried	Field	CC 0002
Mis	Hammer 12mm, Retsch 8mm, Retsch 2 mm	CC 0002	FBR 0007
Mis	Milled		VIR 0001
SCT	Dried	SCM	Rai 0001
SCT	Harvested and dried	Field	Rai 0002
SCT	Cutted 6.25 mm	Rai 0002	FBR 0013
SCT	Cutted 6.25 mm, Retsch 8 mm, sieved <10 mm	Rai 0002	FBR 0015
SCT	Cutted 6.25 mm, Retsch 8 mm, sieved >10 mm	Rai 0002	FBR 1024

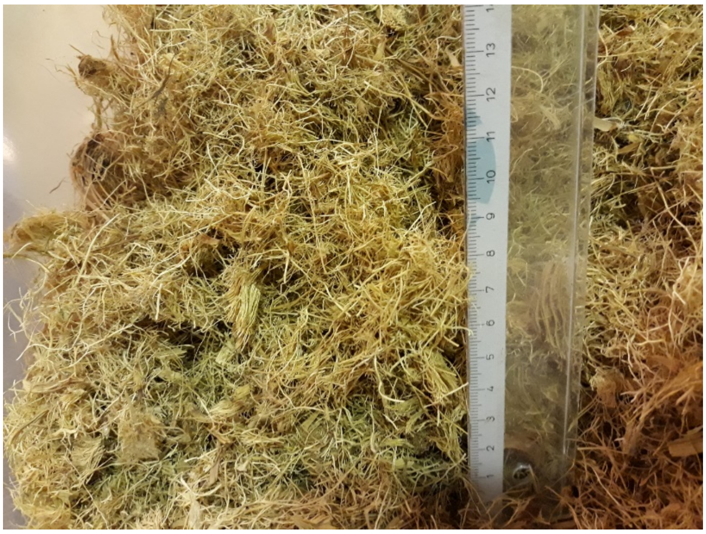

Figure 5 ***EFB Shredded, hammer milled and cutted***

Figure 6 ***Sugar cane trash, cut at 6.25 mm***

4 Biomass characterization

Biomass samples were sent to EuroFins (Appendix 1) and SGS (Appendix 2) for analysis.

Table 3 Characterization of prepared biomass used in CAPCOM experiments

Label	FBR 0008	FBR 0002	CC 0002	VIR 0001	RAI 0001	FBR 0015	
Biomass	**EFB**	**MCF**	**MIS**	**MIS**	**SCB**	**SCT**	**Unit**
Dry Matter	899	871	899	884	878	900	g/kg
Moisture	44	52	40	36	47	35	g/kg
ADL	76	199	100	105	79	60	g/kgDM
NDF	816	790	915	920	891	780	g/kgDM
ADF	536	544	638	648	557	471	g/kgDM
Sodium	0.3	0.1	0.2	0.1	0.1	0.1	g/kgDM
Potassium	20.7	6.5	2.2	3.3	1.4	4.6	g/kgDM
Magnesium	1.4	1.6	0.4	0.6	0.5	1.4	g/kgDM
Calcium	2	2.4	1.3	0.8	0.8	2.9	g/kgDM
Phosphorous	1.2	1.4	0.1	0.4	0.2	0.5	g/kgDM
Sulphur	0.8	1	0.3	0.4	0.3	1.1	g/kgDM
Manganese	21	32	12	31	58	132	mg/kgDM
Zinc	22	43	4	17	10	11	mg/kgDM
Iron	473	1413	125	76	1334	1971	mg/kgDM
Copper	10.5	20.5	1.4	1.8	4.2	4.4	mg/kgDM
Hemi Cellulose*	280	246	277	272	334	309	g/kgDM
Cellulose*	460	345	538	543	478	411	g/kgDM
Acid Detergent Lignin*	76	199	100	105	79	60	g/kgDM

*Hemi Cellulose, Cellulose and Acid Detergent Lignin were calculated from ADL, NDF and ADF (Hemi cellulose = NDF- ADF, Cellulose = ADF – ADL, Lignin = ADL)

The full analysis reports are given in Appendix 1a, 1b and 2.

To explore the potential of nature to improve the quality of life

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