

Characteristic analysis of the mucilage from *Abelmoschus manihot*

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Abstract

The mucilage obtained from the roots of *Abelmoschus manihot* is an important material in the manufacture of Hanji (Korean traditional paper) for dispersivity of *Broussonetia kazinoki* bast fibers and separation of each paper from a pile of wet papers. *A. manihot* called 'Dakpul' in Korea is an annual herbaceous flowering plant belonging to the *Malvaceae* family. To understand the role of *A. manihot* mucilage in the manufacture of Hanji, it is necessary to study its chemical properties. In this study, chemical characterization of mucilage obtained from *A. manihot* root was carried out using Thermogravimetry analysis (TGA), Pyrolysis-Gas Chromatography/Mass Spectrometry (Py-GC/MS), Fourier Transform-Infrared Spectroscopy (FT-IR). The constituent of monomeric sugar (*Rhamnose*, *Arabinose*, *Xylose*, *Mannose*, *Galactose*, *Glucose*) and uronic acid (*Galacturonic acid*, *Glucuronic acid*) components were also analyzed after sulfuric acid hydrolysis.

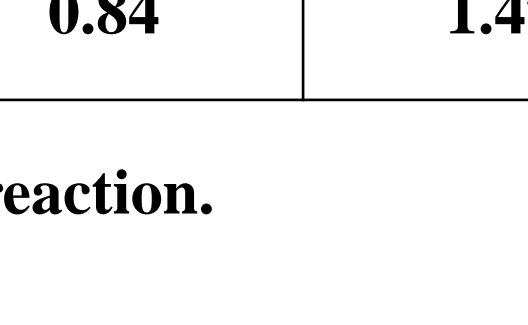
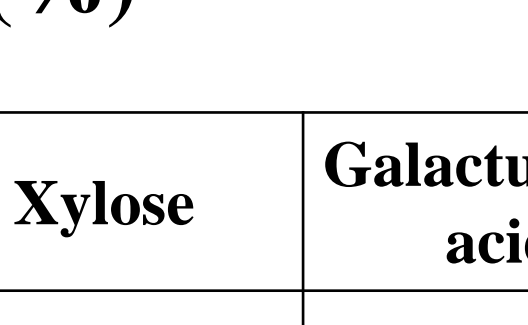
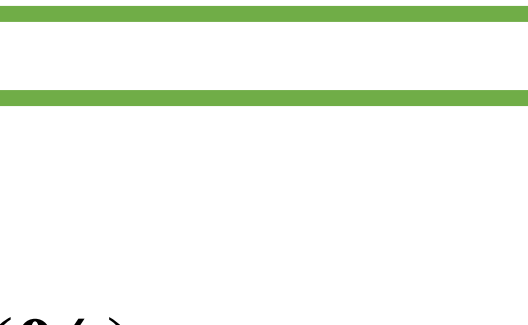
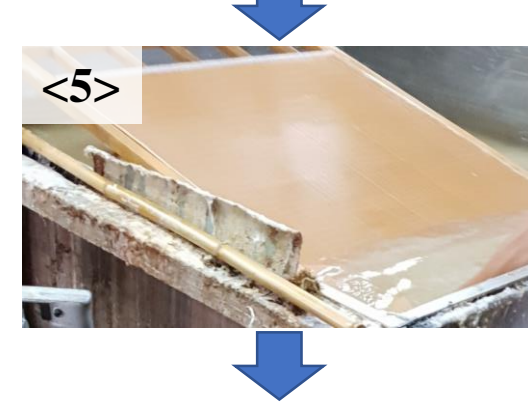
Introduction

< *Abelmoschus Manihot* >



< Manufacturing process of Hanji >

1. Harvest and steaming, peeling bark to make white bark of paper mulberry tree
2. Cooking of the white bark using lye
3. Washing the cooked mulberry sunlight bleaching of the bast fiber, and cleaning impurities
4. Disintegrating mulberry fibers and mixing with 'mucilage of *Abelmoschus manihot* roots' (darkpul)
5. Forming the wet sheet (Hanji)
6. Removing the water from the mat of sheet by pressing
7. Drying the sheet



Instruments and Methods

Pyrolysis-GC/MS	Thermo chemical analysis
FT-IR	Surface Functional group analysis
TGA	Thermogravimetric analysis
Bio-LC	Sugar and uronic acid analysis
HyperCOOL	Freeze drying



HyperCOOL



TGA (Pyris 1, Perkin Elmer)



Pyrolysis-GC/MS (Agilent Tech.)



FT-IR (Nicolet iS10, Thermo)



Bio-LC (Dionex ICS-5000+, Thermo)

Result and Discussion

❖ Sugars & Uronic acid composition (%)

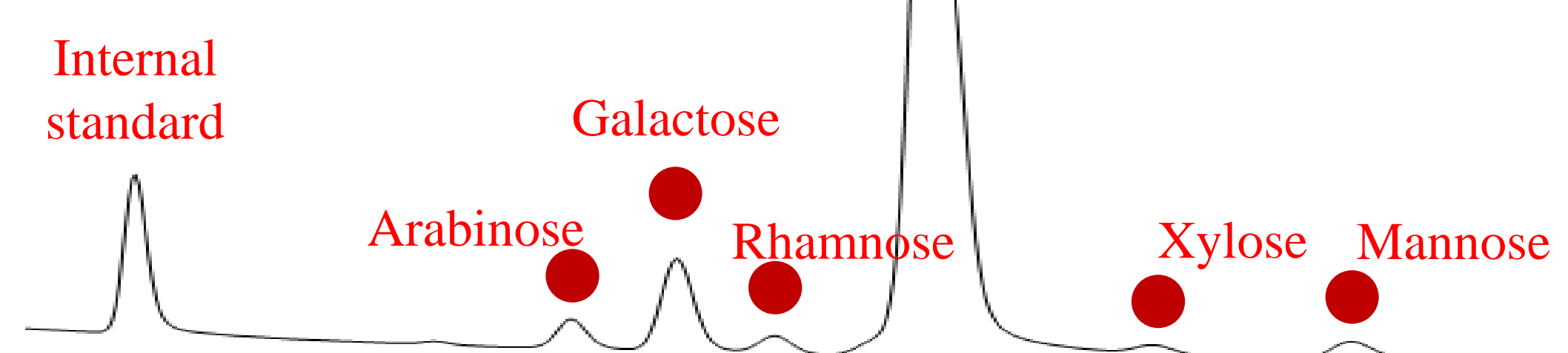
Glucose	Rhamnose	Galactose	Mannose	Arabinose	Xylose	Galacturonic acid	Glucuronic acid
76.22	10.03	4.71	3.29	0.95	0.84	1.47	2.49

*Sugars & uronic acid composition were obtained after H₂SO₄ hydrolysis reaction.



A. *Manihot* mucilage Powder

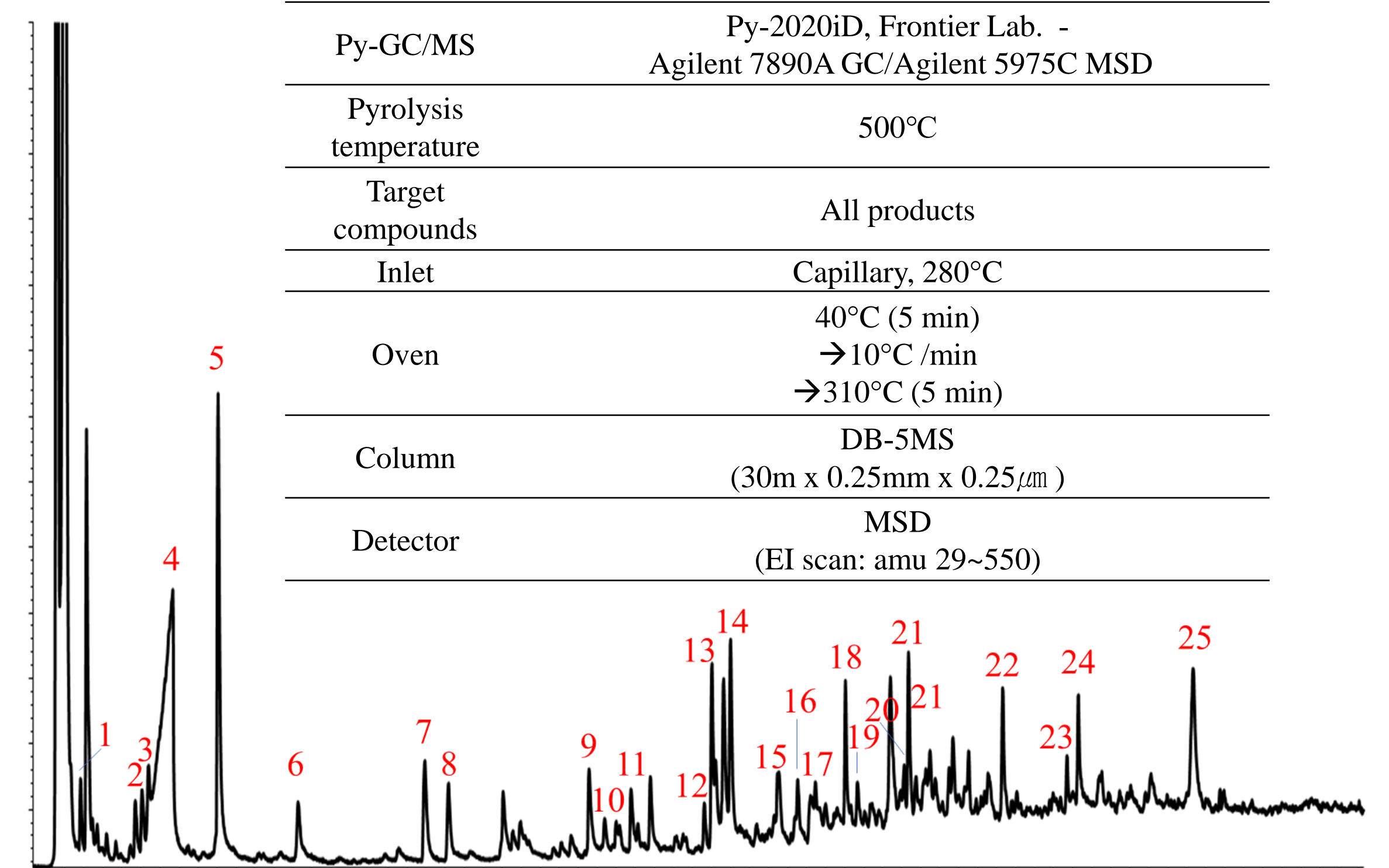
< H₂SO₄ hydrolysis reaction >
 - Sample : 25 mg / H₂O 4.45ml / H₂SO₄ 0.55ml
 - Temperature : 100°C
 - Time : 2hr
 - Internal standard : Fucose



❖ Pyrolysis - Gas Chromatography/Mass Spectrometry

< Analysis condition >

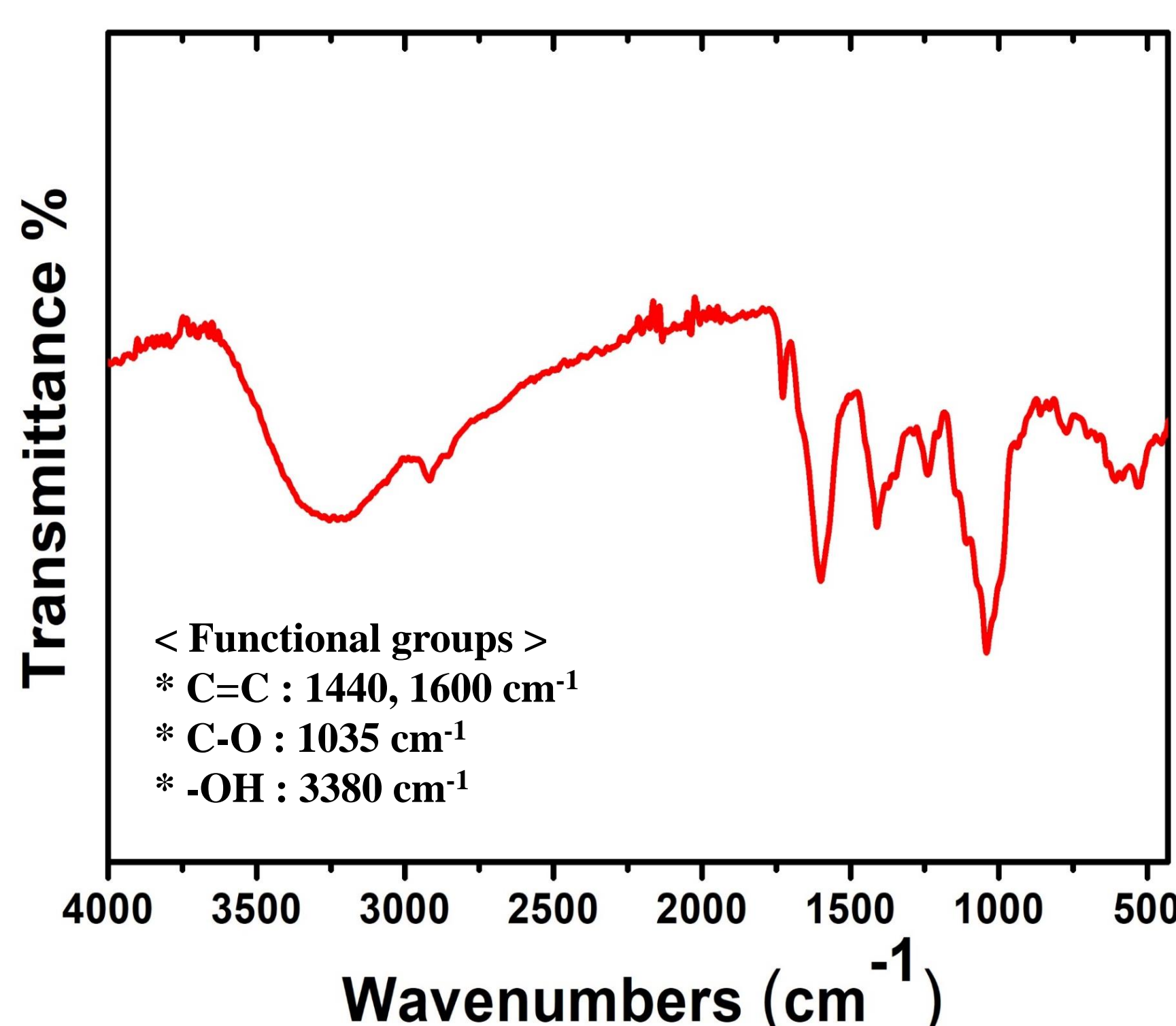
Py-GC/MS	Py-2020iD, Frontier Lab. - Agilent 7890A GC/Agilent 5975C MSD
Pyrolysis temperature	500°C
Target compounds	All products
Inlet	Capillary, 280°C
Oven	40°C (5 min) → 10°C/min → 310°C (5 min)
Column	DB-5MS (30m x 0.25mm x 0.25µm)
Detector	MSD (EI scan: amu 29-550)



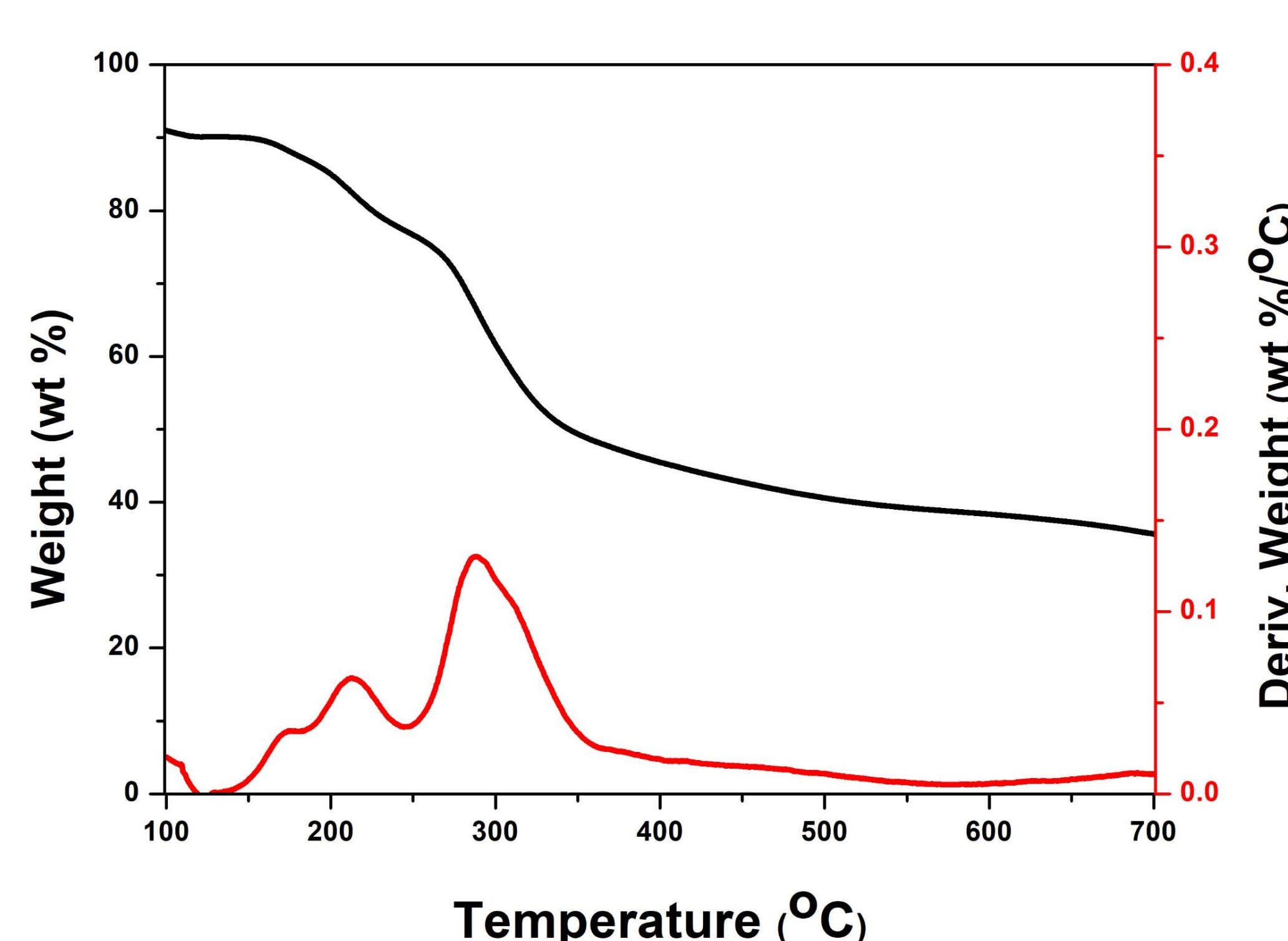
Pyrolysis chromatogram and pyrolysis products

1	Trimethylamine	16	Phenol
2	2-Butanone	17	2-Furanmethanol
3	Furan, 2-methyl-	18	2-Cyclopenten-1-one, 2-hydroxy-3-methyl-
4	Acetic acid		
5	2-Propanone, 1-hydroxy-	19	2-Cyclopenten-1-one, 2,3-dimethyl-
6	Furan, 2,5-dimethyl-	22	1,4:3,6-Dianhydro-α-D-glucopyranose
7	1H-Pyrrole		
8	Toluene	20	Phenol, 2-methoxy-
9	2-Cyclopenten-1-one	21	anhydro - sugar
10	1H-Pyrrole, 2-methyl-	23	Indole
11	2-Furanmethanol		
12	2-Cyclopenten-1-one, 2-methyl-	24	2-Methoxy-4-vinylphenol
13	2(3H)-Furanone, dihydro-	25	Levoglucosan
14	2-Furanmethanol		
15	2-Furancarboxaldehyde, 5-methyl-		

❖ FT-IR analysis



❖ A. Manihot TG & DTG



Conclusions

- As a result of chemical composition analysis, Glucose content was the highest(76.22%), followed by Rhamnose, Galactose, Mannose, Glucuronic acid, Galacturonic acid, Arabinose, and Xylose.
- Thermal decomposition of *A. Manihot* was finished at around 450°C and Acetic acid, Levoglucosan and N compounds were mainly detected by thermochemical analysis.
- FT-IR analysis showed the presence of C=O, C-O, -OH functional groups on the surface of *A. manihot* mucilage powder