

Recovery of betulin by commercial resins from silver birch bark

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Background



➤ Silver birch (*Betula pendula*) bark is a bulk side stream of Finnish pulping, mostly burned for energy rather than valorised. The outer bark is rich in betulin, the triterpenoid that gives it a white color and defends the tree against pathogens. [1]

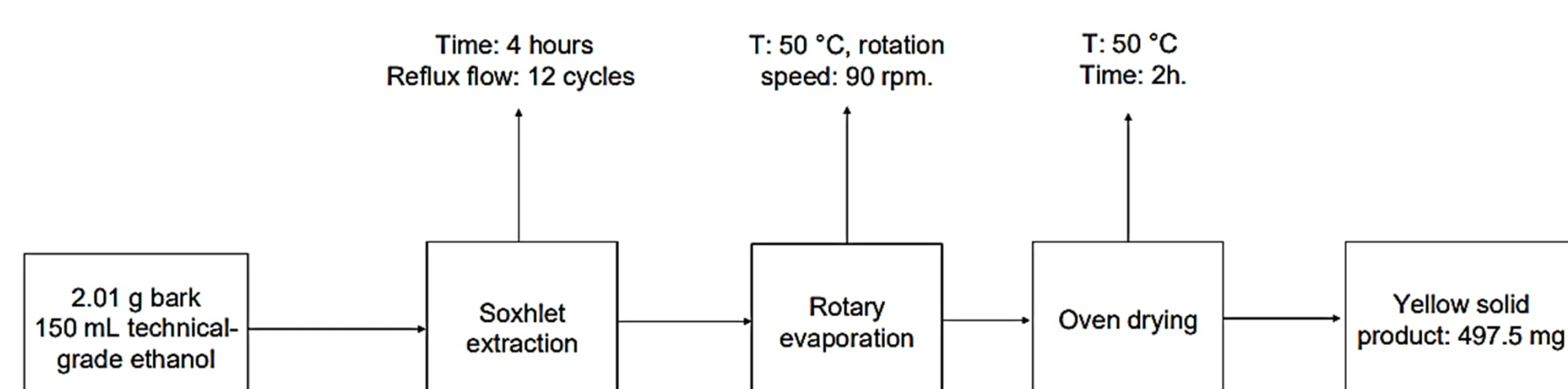
- Betulin shows *antitumor, antiviral, and anti-inflammatory activity, valuable for pharma and cosmetics*.
- The outer bark can hold up to **25%** betulin by dry weight.
- Current purification needs **multi-stage recrystallisation** in hydrocarbon solvents, which is **costly and unsustainable**. [2]

Aim of the Study

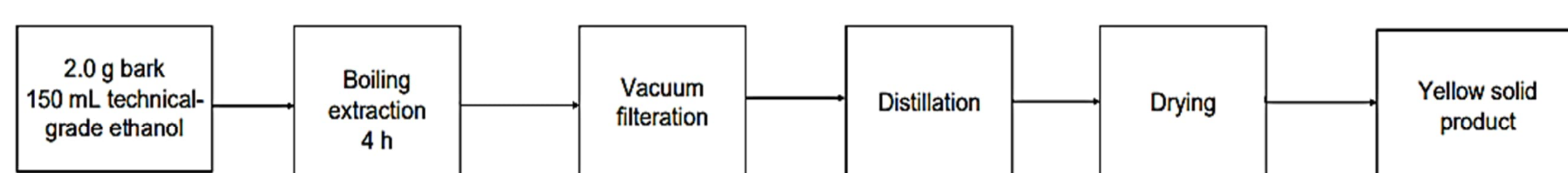
- Develop a simple, low-solvent extraction method with high betulin yield.
- Identify and quantify betulin and related triterpenoids by GC-MS.
- Screen commercial resins for selective betulin recovery.
- Characterise the best resin's equilibrium, kinetics, and regeneration behavior.

Extraction of Betulin from Birch Bark

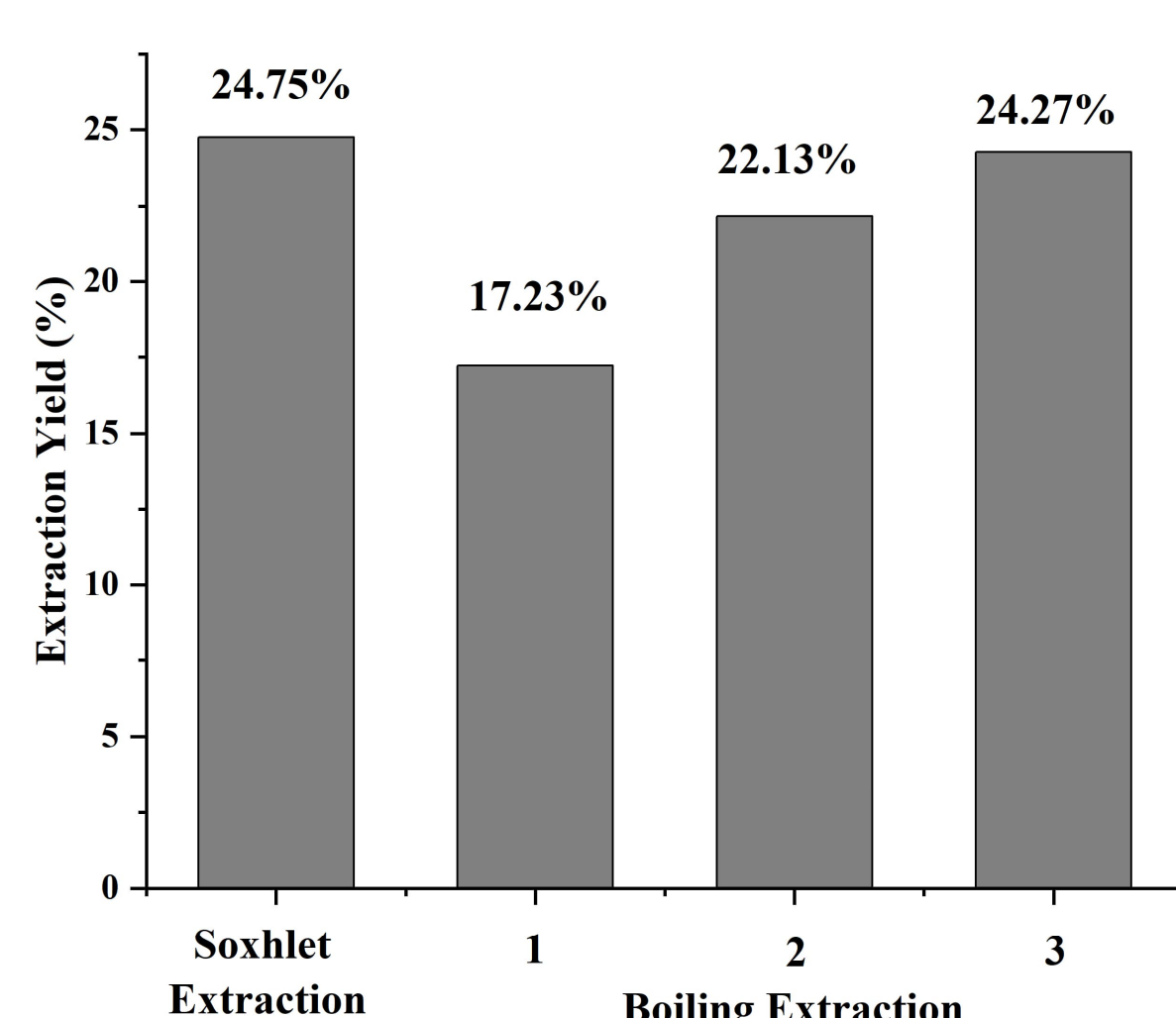
Soxhlet Extraction



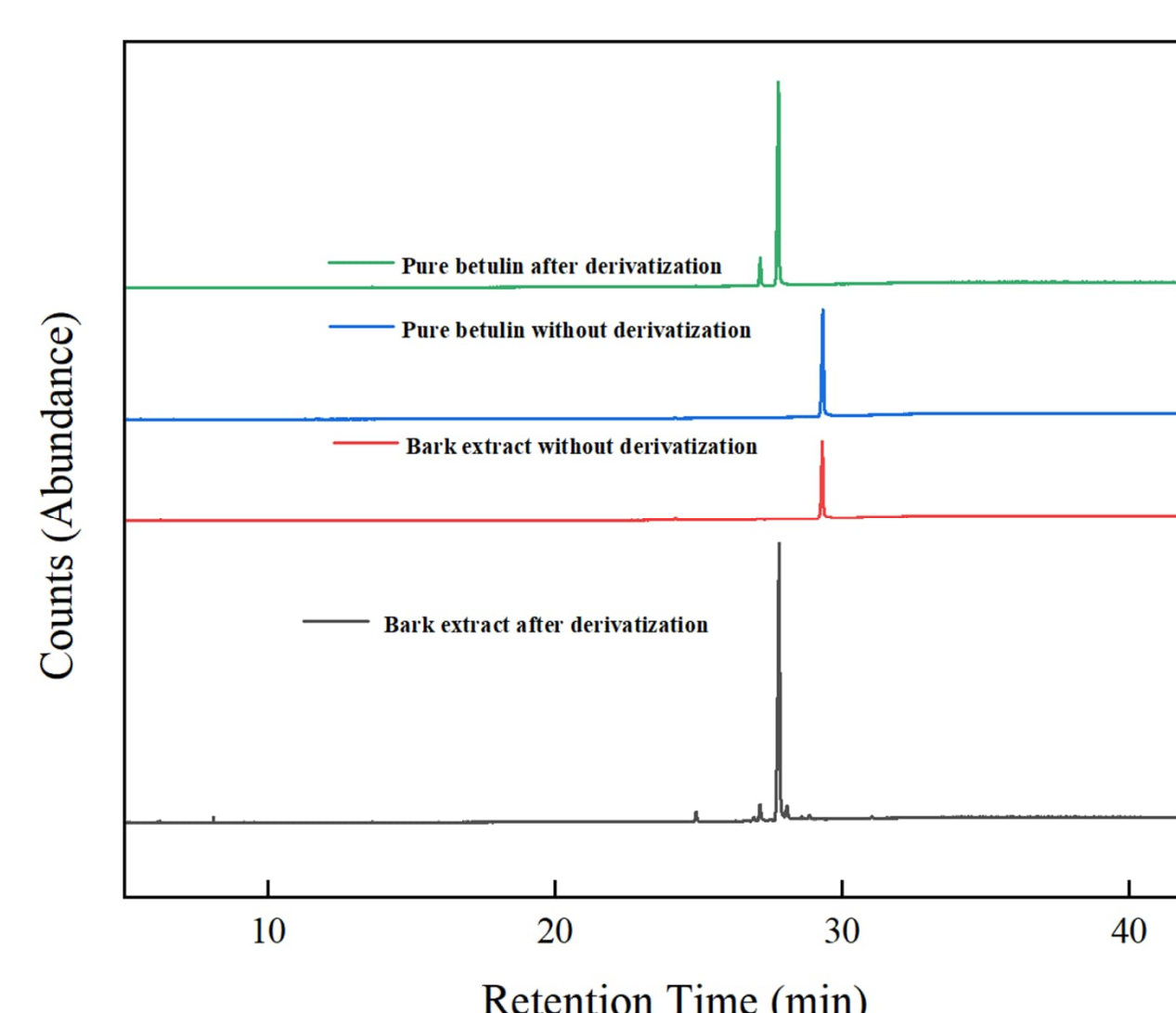
Direct Boiling Extraction



Extraction Yield & GCMS



Soxhlet extraction gave the most consistent yield. Direct boiling reached a comparable 24.3% once the ethanol volume and solid: liquid ratio were optimized.



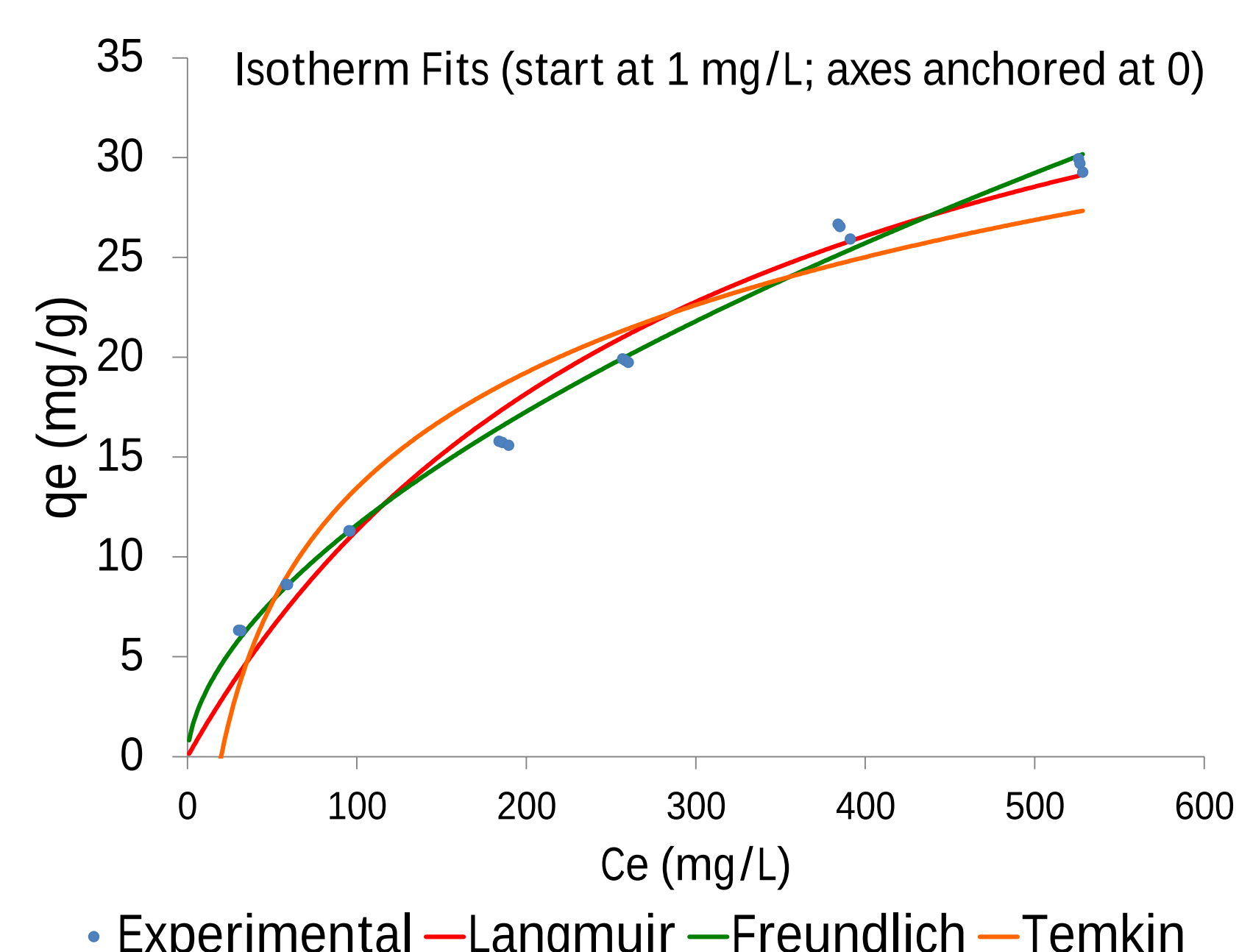
Samples were silylated with BSTFA / pyridine (2:1) to convert hydroxyl and carboxyl groups to their TMS derivatives, which shifted peaks earlier and sharpened the signal.

Screening Resins for Betulin Recovery

Table 1. Betulin adsorption capacities of resins

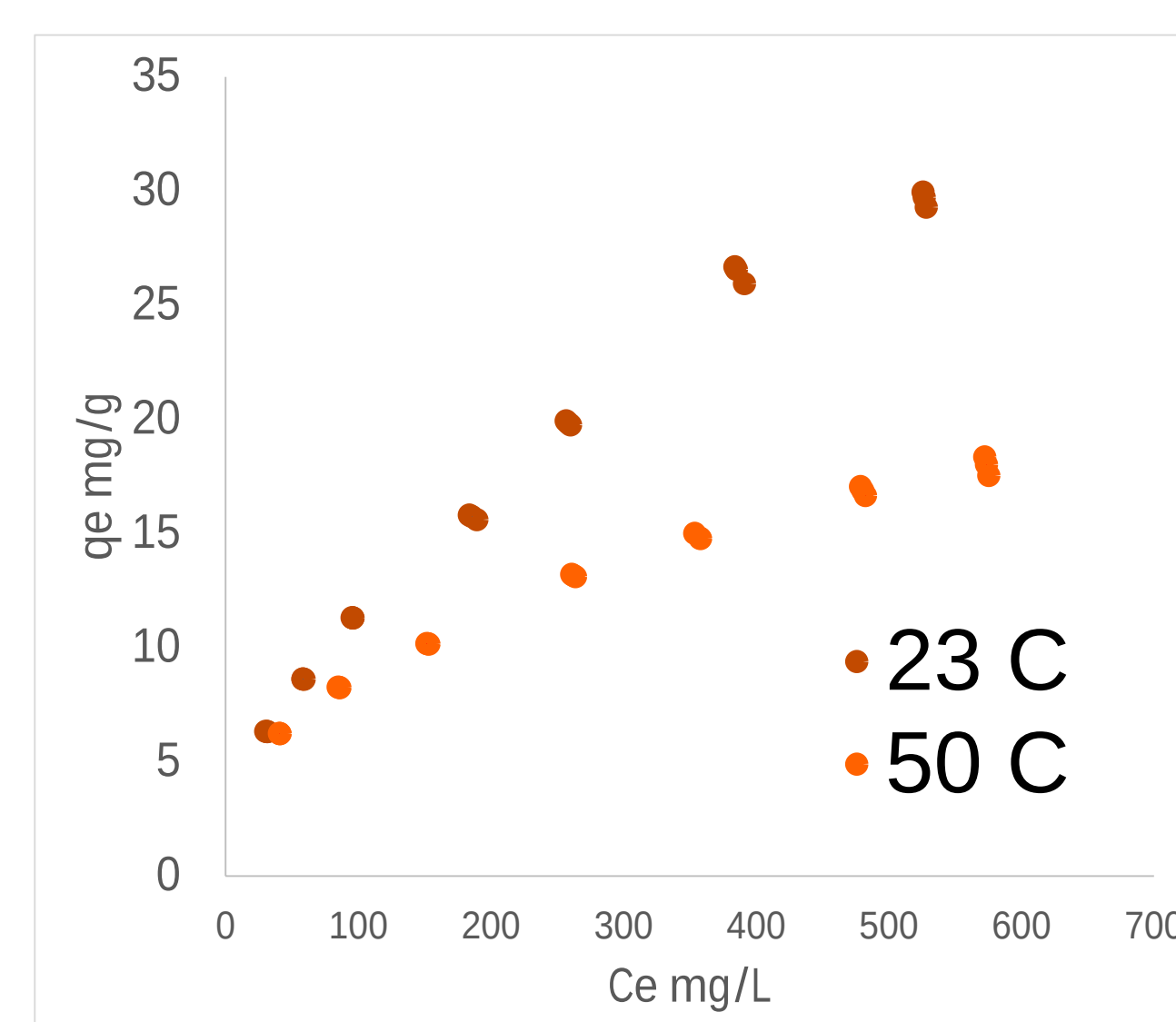
Resin	C0 mg/L	Ethanol-water ratio/V	qe mg/g	Removal efficiency %	qe dry mg/g
SBA	150	1:0	-	-	-
XAD16N	150	1:0	0.17	12%	-
PAD500	150	1:0	0.09	6%	-
PAD400	150	1:0	0.18	12%	0.34
MN270	150	1:0	0.43	29%	-
PAD400	3000	1:0	2.05	7%	3.77
MN270	3000	1:0	2.92	10%	-
PAD400	1000	10:1	4.04	38%	7.42
PAD400	670	5:1	3.82	57%	7.01
MN270	630	5:1	3.73	60%	-
MN200	650	5:1	4.88	76%	12.63
MN202	650	5:1	1.19	18%	-
SBA	150	2:1	-	-	-
XAD16N	150	2:1	1.29	76%	-
PAD500	150	2:1	1.29	76%	-
PAD400	150	2:1	1.32	78%	2.43
MN270	150	2:1	1.14	71%	-

Adsorption Isotherm for MN200

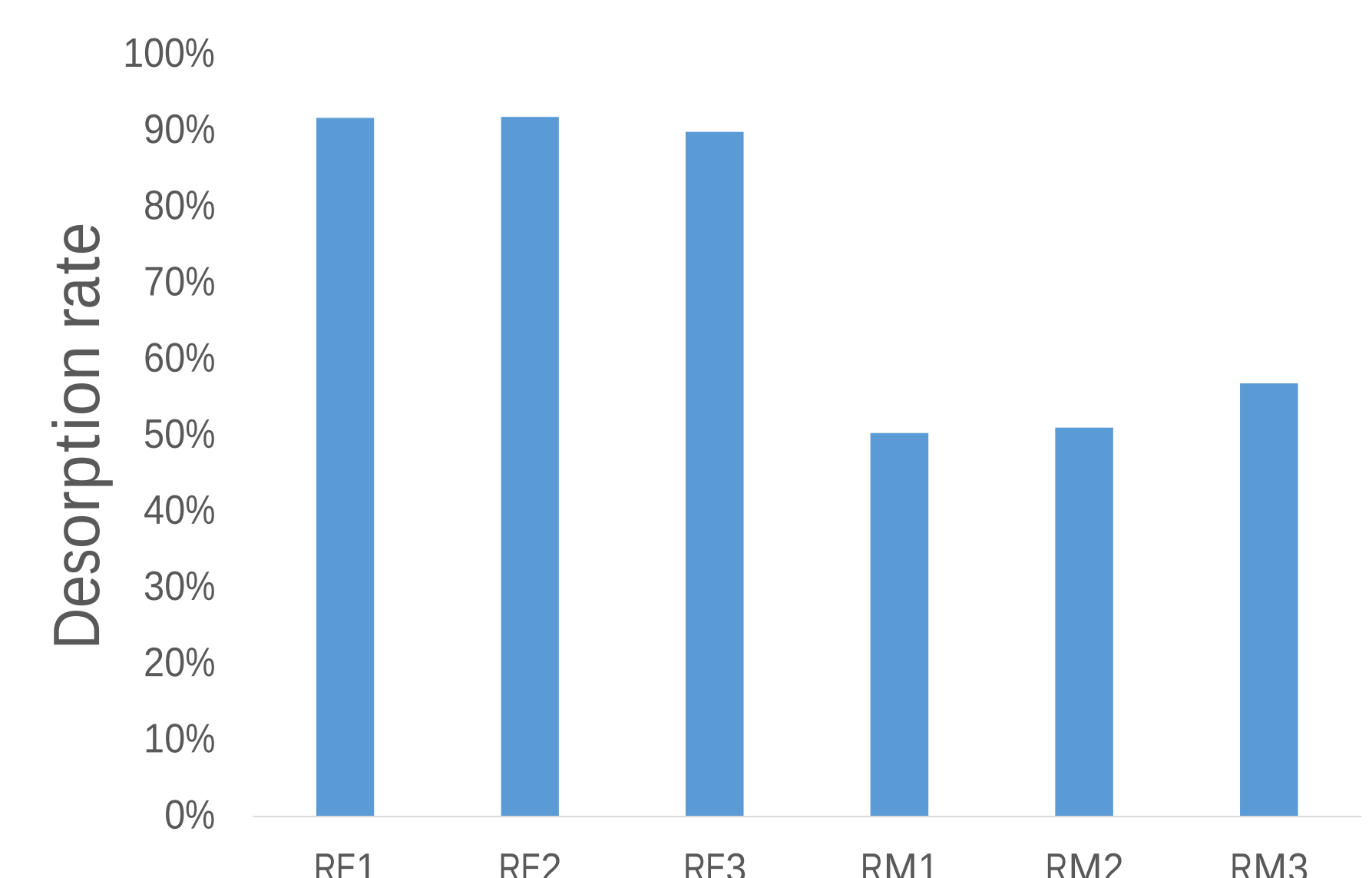


Isotherm	Parameter		R ²
Langmuir	q _m (mg/g)	K _L (L/mg)	0.9756
	46.02	0.003270	
Freundlich	n	K _f (mg/g·(L/mg) ^{1/n})	0.9939
	1.743	0.8276	
Temkin	α (L/g)	β (J/mol)	0.9373
	0.05036	8.334	

Adsorption & Desorption in MN200



Experimental data on betulin adsorption by MN200 at RT and 50°C



Desorption rates of betulin from MN200 with regeneration agents RE (ethanol) and RM (methanol).

Conclusions

- Simplified method has been proven efficient for extracting betulin and other compounds from silver birch bark.
- Relatively effective resin, MN200 from Purolite/Ecolab, was chosen for the recovery of betulin from silver birch bark extract in *ethanol-water (5:1) solution*.
- *Betulin-uptake capacity of 46.02 mg/g.*

Ongoing Work

- Test the *preparative chromatography* process for continuous production and to increase the purity of the recovered betulin.

References

[1] Gomes, E.D.; Rodrigues, A.E. Sep. Purif. Technol. 2019, 216, 92–101.

[2] Guiochon, G. J. Chromatogr. A 2002, 965(1–2), 129–161.