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Optimization of polysaccharides extraction from Spent coffee grounds (SCGs) by pressurized hot water extraction

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Introduction

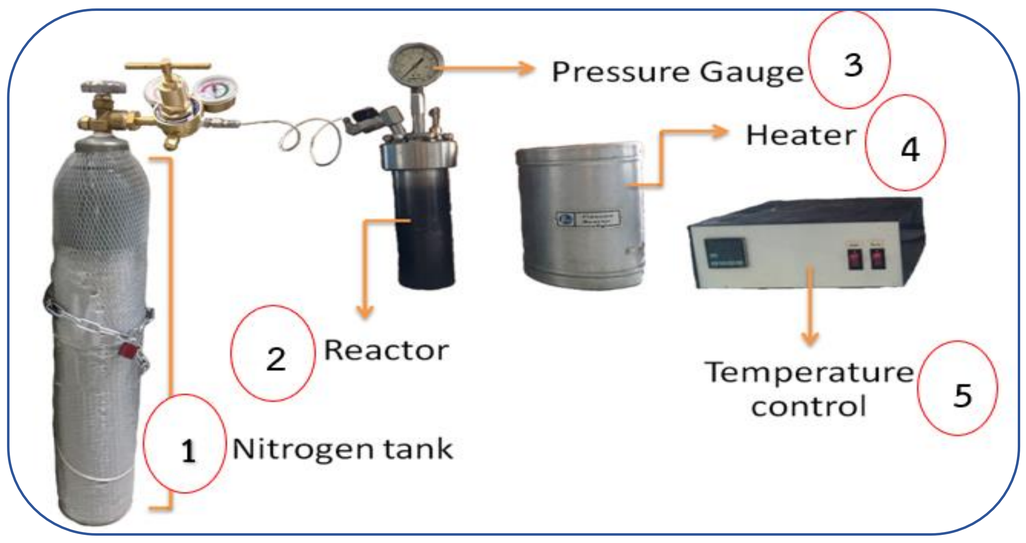
Spent coffee grounds (SCGs) are a by-product of the food industry, which contains a rich source of polysaccharides. They contain polysaccharide (45-47%), oil or lipids (9-16%), protein (13-17%), phenolic compounds (1.7-3.5%), caffeine (0.5-1.2%), and other minerals (1.6%) [1], depending on the coffee's species, roasting, grinding, and brewing process. This research was to study the extraction of polysaccharides from SCGs by environmentally friendly technic of pressurized hot water. The process optimization was investigated by response surface methodology (RSM) to produce the highest extraction yield. The pressurized hot water showed an efficient technique to recover polysaccharides from SCG.

Materials and Methods

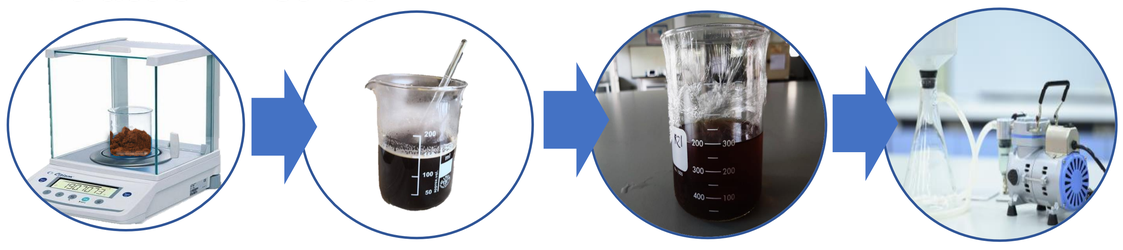
The SCGs used in this study was supplied by Starbucks, V Market branch, Ladkrabang, Bangkok, Thailand.

The SCGs sample were dried at 40 °C for 24 hours

- **Pressurized Hot Water Extraction**



- **Extraction method**



20 g of dried SCGs → Mixed with Distilled water, ratio of 1:15 g SCGs/ml water → Extracted SCGs by Hot compress water → Filleted by paper filter No.1

Recovery of Polysaccharides

Mixed Extracts SCGs 100ml: EtOH 200ml 24 hr. → Evaporated by Rotary evaporator at 50 °C. → Dried a precipitate at 40°C for 24 hr.

Acknowledgements

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[1] Burniol-Figols, A.; Cenian, K.; Skiadas, I.V.; Gavala, H.N. Integration of chlorogenic acid recovery and bioethanol production from spent coffee grounds. *Biochemical Engineering Journal* **2016**, *116*, 54-64.

Results and Discussion

Table.1 A Central composite design matrix and the response values for the extraction yield of polysaccharide.

Run	Actual process variables			%Yield
	Temperature (°C)	Pressure (bar)	Extraction time (min)	
1	100	2	120	11.5100
2	100	2	120	11.5550
3	80	4	60	10.1562
4	80	4	60	9.1000
5	80	4	180	9.4061
6	80	4	180	9.4061
7	120	4	60	12.2650
8	120	4	60	15.2737
9	120	4	180	14.1212
10	120	4	180	13.2937
11	100	8	30	10.6625
12	100	8	30	9.8187
13	70	8	120	8.6712
14	70	8	120	8.2537
15	100	8	120	9.9675
16	100	8	120	10.1650
17	130	8	120	14.9100
18	130	8	120	16.1700
19	100	8	210	10.7050
20	100	8	210	9.9962
21	80	12	60	7.3437
22	80	12	60	9.6975
23	120	12	60	10.6075
24	120	12	60	13.7875
25	80	12	180	9.3637
26	80	12	180	8.5587
27	120	12	180	13.6300
28	120	12	180	14.8700
29	100	14	120	11.4375
30	100	14	120	9.5612

Table. 2 The analysis of variance (ANOVA) table for the response surface quadratic model of %yield of polysaccharides.

Source	Sum of Squares	df	Mean Square	p-value
Model	140.62	9	15.62	< 0.0001
A (Temperature)	125.66	1	125.66	< 0.0001
B (Pressure)	2.73	1	2.73	0.1033
C (Extraction Time)	0.9019	1	0.9019	0.3384
AB	0.0684	1	0.0684	0.7898
AC	0.7850	1	0.7850	0.3710
BC	1.93	1	1.93	0.1670

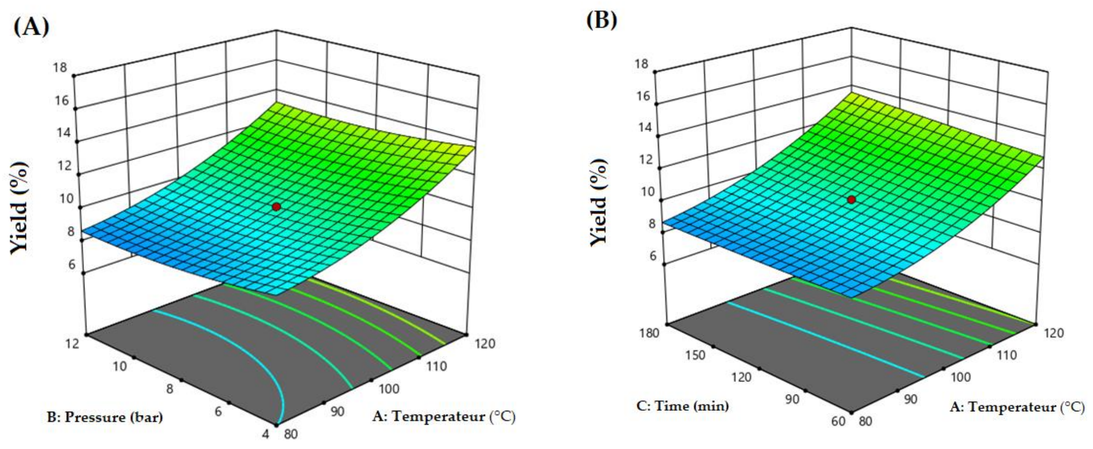

Figure 1. Response surface plot demonstrating the effect of (a) temperature and pressure and (b) temperature and extraction time on %yield of polysaccharides

➢ **Optimal condition of the highest polysaccharide yield**

Operating parameter	Optimal Condition	%Yield	
		Predicted value	Actual value
Temperature (°C)	120	13.782	13.71±53
Pressure (bar)	4		
Extraction time (min)	60		

Conclusions

The polysaccharides from Spent coffee grounds (SCGs) have been successfully extracted by pressurized hot water in this study. The temperature was observed as the main influence on the increasing of %polysaccharides yield. The optimization condition was temperature of 120 °C, pressure of 4 bar, and extraction time of 60 min. Under this optimal condition, the highest extraction yield was 13.71±53% and the total phenolic content was 11.13 ± 1.33 mg gallic acid equivalent (GAE)/g dry SCG