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The XXI International Grassland Congress / VIII International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

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Study on the supercritical fluid extraction techniques of alfalfa chlorophyll

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Key words: alfalfa, chlorophyll, supercritical CO₂, extraction, techniques

Introduction Alfalfa is a high quality and productive forage containing abundant chlorophyll. Extracting natural chlorophyll from alfalfa can improve its added value. The supercritical fluid extracted technology is a "green extracted technology" to obtain high-quality natural chlorophyll.

Material and method

Material *Medicago sativa* var. Gannong No. 3

Method Technical process:

Alfalfa → Mow → Clean → dry → stave → sieving → weigh → supercritical CO₂ extract → evaporate → column chlorophyll → product

Optimize the technique parameters and gain optimum condition through L₉(3⁴) orthogonal experiment.

Results and analysis

Direct-viewing analysis of orthogonal experiment.

Table 1 The design and results of L₉(3⁴) orthogonal experiment of supercritical CO₂ extraction of alfalfa chlorophyll.

Number	A*	B	C	D	E
1	26	40	8	1	0.523
2	26	45	10	2	1.828
3	26	50	12	3	1.904
4	30	40	10	3	3.409
5	30	45	12	1	2.18
6	30	50	8	2	2.68
7	34	40	12	2	0.344
8	34	45	8	3	0.135
9	34	50	10	1	2.29
K1	1.418	1.425	1.113	1.664	15.293
K2	2.756	1.381	2.509	1.617	
K3	0.923	2.291	1.476	1.816	
R	1.833	0.910	1.396	0.199	

* A-extraction pressure(MPa) B-extraction temperature(°C), C-CO₂ flux(l/h), D-error, E-Chlorophyll content(mg/g)

Factors affect extraction of supercritical CO₂ can be ranked as extractive pressure > CO₂ flow > extractive temperature, optimum condition is extractive pressure 30Mpa, CO₂ flow 10L/h, extractive temperature 50°C. Chlorophyll content gained by the optimum technique is 3.897mg/g.

Results of Variance analysis

Table 2 The analysis of variance.

origin	DF	Sum of squares	Mean square	F Value
A	2	5.388362	2.694181	68.87327**
B	2	1.573196	0.786598	20.10836**
C	2	3.150173	1.575536	40.27656**
error	2	0.078236	0.039118	
total	8	10.19087		

The results indicated that extractive pressure is the most important factor, CO₂ flow determine extractive efficiency. Different CO₂ flow result in different retention time in the extractive cauldron and different extractive efficiency. Extractive temperature also plays an important part, it determines not only dissolving but stability of active substance in alfalfa.

Conclusion Optimum parameters of extraction by supercritical CO₂ is extractive temperature 50°C, extractive pressure 30Mpa, CO₂ flow 10L/h, Chlorophyll content gained by the condition is 3.897mg/g.