CHINESE NITRARIA TANGUTORUM BOBR.: CHEMICAL CONSTITUENTS OF SEED OIL EXTRACTED BY SFE-CO_2

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Abstract In order to develop and make good use of *Nitraria tangutorum* Bobr. in Qinghai-Tibetan Plateau for its ecological and medicinal values, the seed oil was extracted by SFE-CO_2 and the chemical constituents was analyzed by GC/MS. The component relative contents were determined by area nomalization. 28 components were separated from the extracts of SFE-CO_2 and 12 of them, which accounted for 85.99% were identified. They were (*Z*, *Z*)-9, 12-octadecadienoic acid (linoleic acid), bicyclo[10.1.0]tridec-1-ene, 7-pentadecyne, gamma-sitosterol, gamma-tocopherol, 1, *E*-8, *Z*-10-hexadecatriene, 9, 12-octadecadienal, 24-methyl-5-cholestene-3-ol, (*Z*)-9, 17-octadecadienal, stigmastan-3, 5-dien, eicosane and so on. Among them, the relative content of (*Z*, *Z*)-9, 12-octadecadienoic acid is the highest, accounting for 65.85% of the total area. It is concluded that *N. tangutorum* Bobr. seed oil is a rich source of linoleic acid.

Key words *Nitraria tangutorum* Bobr.; chemical constituents; SFE-CO_2; GC/MS; linoleic acid

1 Instroduction

Plants belonging to Zygophyllceae family *Nitraria* genus are generally called *Nitraria*, which are widely distributed in desert and arid areas. This kind of shrubs is well adapted under bad conditions such as aridness and saline-alkali soils, due to its natural capacity against wind and sand, it is often used for sand and soil conservation[1]. *Nitraria* plants are the main dominant species in desert areas on Qinghai-Tibetan Plateau. Both *N. tangutorum* Bobr. and *N. sibirica* Pall. are the natural distributing species in this area, and the former is the special specie in China[2]. It was reported that the fruits and seeds of *N. tangutorum* Bobr. were used among village folks to cure the weakness of spleen and stomach, indigestion, neurasthenia and cold[3], and its leaves were used to treat convulsion, neuralgia, arrhythmia, etc.[4]. Due to their ecological and medicinal values, seed oil was extracted by supercritical CO_2 fluid and its components were analyzed by GC/MS, which provided the basic data for the further development of *Nitraria* resources.

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2 Experimental

2.1 Plant material

Nitraria tangutorum Bobr. seeds on Qinghai-Tibetan Plateau were obtained by Qinghai-Tibetan Plateau Biological Production Company in Haixi County, Qinghai Province.

2.2 Apparatus

Supercritical Fluids Extraction (SFE) instrument: HL-20L type cycling SFE equipment (Meichen Medical Limited Corporation, Guangzhou, Guangdong Province).

GC/MS instrument: HP6890/5973 (HP, USA)

2.3 Methods

2.3.1 Extraction

The *Nitraria tangutorum* Bobr. seeds were smashed to powders with diameters about 1.0 mm. 10.8 kg powders were weighed and extracted in the extraction pot.

During the extraction process, the optimization condi-

tions of this method were: CO_2 fluids used in cycle at the flow rate 46 l/h; extraction pressure 22.0 MPa; extraction temperature 42.0 ℃; separation Ⅰ pressure 10.5 MPa; temperature 56.0 ℃; separation Ⅱ pressure 6.8 MPa; temperature 42.0 ℃; extract period 8 hours; and the total extracts ratio 11.6 %.

2.3.2 Separation and identification

2.3.2.1 Conditions for separation by GC

Chromatogram column standard: HP-5MS quartz capillary (50 m × 0.25 mm × 0.25 μm); Column temperature: 45～280 ℃; temperature acceleration rate: 3 ℃/min; temperature in gasification chamber: 300 ℃; carrier gas: He; pressure before passing chro-matogram column: 59.8 kPa; fractional ratio: 50∶1; and injection volume of samples: 0.3 μl per sample.

2.3.2.2 Conditions for identification by MS

EI ion source and electric energy: 70 eV; temperature of ion source: 230 ℃; scanning scale: in the range of 33～555 u; scanning speed: 0.5 s/dec.

2.3.2.3 Data processing and searching by mass spectrum

The components of extracts were separated through quartz capillary by GC, and mass spectrogram of each separated part was recorded by mass spectrograph. The chemical structures of components were searched and identified by NIST-Wiley databases. Furthermore, their relative contents were determined with area normalization method.

3 Results and Discussion

The components of *Nitraria tangutorum* Bobr. seed oil have not been analyzed previously. This study is the first to extract its seed oil by SFE-CO_2. The extracts were obtained and the chemical constituents were identified by GC/MS.

Results given in Table 1 showed the component with highest content (65.85 %) of extracts was (*Z*, *Z*)-9, 12-octadecadienoic acid (linoleic acid). In addition, the other components from high relative content to low one were: bicyclo [10.1.0] tridec-1-ene; 7-pentadecyne; gamma-sitosterol; gamma-tocopherol; 1, *E*-8, *Z*-10-hexadecatriene; 9, 12-octadecadienal; 24-methyl-5-cholestene-3-ol; (*Z*)-9, 17-octadecadienal; stig-mastan-3, 5-dien; eicosane; and (*R*)-(-)-14-methyl-8-hexadecyn-1-ol.

Table 1 Identified chemical components of Nitraria tangutorum **Bobr. seed oil extracted by SFE-CO_2**

Peak No.	Chemical constituent	Formula	Molecular weight	Relative content %
1	(*R*)-(-)-14-Mehtyl-8-hexadecyn-1-ol	$C_{17}H_{32}O$	252	0.17
2	(*Z*, *Z*)-9, 12-Octadecadienoic acid	$C_{18}H_{32}O_2$	280	65.85
3	9, 12-Octadecadienal	$C_{18}H_{32}O$	264	1.15
4	(*Z*)-9, 17-Octadecadienal	$C_{18}H_{32}O$	264	0.79
5	7-Pentadecyne	$C_{15}H_{28}$	208	2.11
6	Eicosane	$C_{20}H_{42}$	282	0.47
7	1, *E*-8, *Z*-10-Hexadecatriene	$C_{16}H_{28}$	220	1.27
8	gamma-Tocophyerol	$C_{28}H_{48}O_2$	416	1.56
9	Stigmastan-3, 5-dien	$C_{29}H_{48}$	396	0.57
10	24-Methyl-5-cholestene-3-ol	$C_{28}H_{28}O$	380	1.05
11	gamma-Sitosterol	$C_{29}H_{48}O$	412	4.91
12	Bicyclo[10.1.0]tridec-1-ene	$C_{13}H_{22}$	178	6.09

Linoleic acid is the essential unsaturated fatty acid for human body, the precursor to synthesize γ-linolenic acid which can turn into arachidonic acid. It is worth mentioning that epidemiological studies show that the probability of coronary artery disease decreases linearly with the increase of quantities of the unsa-turated fatty acids in food stuff[5]. Moreover, studies on human using diets rich in linoleic acid show that in the groups provided with higher amounts of soybean oil (50 % linoleic acid content), the mortality rate due to coronary artery disease decreases significantly[6]. Therefore, linoleic acid plays an important role in human life for its anti-oxidative and health care properties. The seed oil of *Nitraria tangutorum* Bobr. in Qinghai-Tibetan Plateau, is a rich source of linoleic acid.

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中国唐古特白刺:二氧化碳超临界萃取种子油化学成分的研究

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摘 要 为开发和利用白刺生态和药用的双重价值,运用气相色谱-质谱联用技术,分析研究青藏高原唐古特白刺超临界二氧化碳萃取种子油的化学成分。应用色谱面积归一法测定了各成分的相对百分含量。从检出的 28 个化合物中共鉴定了 12 种成分,占总量的 85.99 %。分别是(*Z*, *Z*)-9,12-十八碳二烯酸(亚油酸),双环[10.1.0]十三碳-1-烯,7-十五炔,γ-谷甾醇,γ-生育酚,1, *E*-8, *Z*-10-十六碳三烯,9,12-十八碳二烯醛,24-甲基-5-胆甾烯-3-醇,(*Z*)-9,17-十八碳二烯醛,豆甾烷-3,5-二烯,二十烷等。其中,(*Z*, *Z*)-9,12-十八碳二烯酸含量最高,占总量的 65.85 %。

关键词 唐古特白刺;化学成分;超临界二氧化碳萃取;气相色谱-质谱联用;亚油酸

第 2 届"日、韩、中三方生药学联合学术研讨会"(Japan-Korea-China Pharmacognosy(JSP-KSP-CCTNM) Forum 2004)定于 8 月 9 日～11 日在 Kaga 市的 Arrowte 宾馆举行。具体时间安排:

Aug. 9(Monday)
PM 2:00-4:00 Registration and poster attachment
PM 4:00-4:30 Opening Remarks(Japan, Korea, China)
PM 4:30-6:00 Lecture
PM 7:00-9:00 Dinner

Aug. 10(Tuesday)
AM 9:00-10:30 Lecture
AM 10:30-11:00 Coffee break
AM 11:00-12:00 Lecture
AM 12:30-2:00 Lunch
PM 2:00-3:30 Lecture
PM 3:30-6:00 Coffee break
PM 6:00-7:00 Poster presentation
PM 7:00-9:00 Dinner

Aug. 11(Wednesday)
AM 7:30-PM 1:30 Plant Observation Tour
Survey of medicinal plants(*Coptis japanica*)
PM 3:00 Closing Remark(Japan, Korea, China)

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