

**Screening saikosaponin d (SSd)-producing endophytic fungi  
from *Bupleurum scorzonerifolium* Willd**

Yupeng Cheng<sup>1+</sup>, Guangjie Liu<sup>1+</sup>, Zhongmeng Li<sup>1+</sup>, Yongqiang Zhou<sup>2+</sup>, Ning Gao<sup>1\*</sup>,

<sup>1</sup>Key Laboratory of Basic and Application Research of Beiyao (Heilongjiang University of Chinese Medicine), Ministry of Education

<sup>2</sup>Guizhou University of Traditional Chinese Medicine

<sup>+</sup>Authors contributed equally

**\*Corresponding author:**

Ning Gao

Department of pharmacy, Heilongjiang University of Chinese Medicine

Heping Road 24, Harbin, Heilongjiang, China, 150040

Tel: 86-0451-87266869

E-mails: [yupengcheng617@hotmail.com](mailto:yupengcheng617@hotmail.com), [guangjieliu2022@163.com](mailto:guangjieliu2022@163.com), [1157052242@qq.com](mailto:1157052242@qq.com),

[Zhouxiaoqiang1988@163.com](mailto:Zhouxiaoqiang1988@163.com), [gaoning@hljuem.net](mailto:gaoning@hljuem.net),

**CHS<sub>2</sub> ITS sequence:**

TGTAGACAATCTGAGATTTGAGCATCCACCAGACGGGGCTCTACCCTCTATGGCGTCC  
CGTTCCAGGGAAGTTCGGAAGGCACCGCATCAAAGCATCCTCTACAAATTACAACCTCGGGC  
CCGAGAGCCAGATTTCAAATTTGAGCTGTTGCCGCTTCACTCGCCGTTACTAGGGCAATCCC  
TGTTGGTTTCTTTTCTCCGCTTATTGATATGCTTAAGTTCAGCGGGTATTCCTACCTGATCCG  
AGGTCAACATTCAGAAGTTGGGGGTTAACGGCTTGGCCGCGCCGCGTTCCAGTTGCGAGG  
TGTTAGCTACTACGCAATGGAGGCTGCAGCGAGACCGCCACTAGATTCGGGGCCGGGCTG  
GAGTACAGCCCCGATCCCCAACACCAAACCCGGGGGCTTGAGGGTTGAAATGACGCTCGAAC  
AGGCATGCCCCGAGAAATACTGGCGGGCGCAATGTGCGTTCAAAGATTCGATGATTCCTGA  
ATTCTGCAATTCACATACTTATCGCATTTTGCTGCGTTCTTCATCGATGCCAGAACCAAGAGA

TCCGTTGTTGAAAGTTTTGATTTATTTGTTTTTTAGACTCAGAAGTTACACTAAAATCAGAGT  
TTTGTGGTTCCTGCGGCGGGCCGTCCCGTTTTACGGGGCGCGGGCTGATCCGCCGAGGCAAC  
ATAAAGGTATGTTACAGGGGTTTGGGAGTTGTAAACTCGGTAATGATCCCTCCGCTGGTTC  
ACCAACGGAGACCTTGTTACGACTTTTACTTCCTCTAAATGACCGAGTTTGGAGAGCTTTCC  
GGCCCTGAGCGGTAGTTGCCACCCTCTGGGCCAGTCCGGACGCCTCACTGAGCCATTCAA  
TCGGTAGTAGCGACGGGCGGTGTGTACAATAGGGGGGGAGCATATAAAAAGC

**CHS<sub>2</sub> TEF-1 $\alpha$  sequence:**

GACTCACCTTAACGTCGTCGTCATCGGCCACGTCGACTCTGGCAAGTCGACCACTGTGA  
GTACTCTCCTCGACAATGAGCTTATCTGCCATTGTCAATCCCGACCAAGACCTGGCGGGGTAT  
TTCTCAAAGTCAACATACTGACATCGTTTCACAGACCGGTCACCTTGATCTACCAGTGCGGTG  
GTATCGATAAGCGAACCATCGAGAAGTTCGAGAAGGTTAGTCACTTCCCTTCGATCGCGCG  
TCCTTTGCCCATCGATTTCCCTACGACTCGAAACGTGCCCGCTACCCCGCTCGAGACAAA  
AATTTTGCAATATGACCGTAATTTTTTTTTGGTGGGGCACTTACCCCGCCACTTGAGCGACGGG  
AGCGTTTGCCCTCTTCCATTCTCACAACCTCGATGAGTGCCTCGTCACGTGTCAAGCAGTC  
ACTAACCATTCAACAATAGGAAGCCGCTGAGCTCGGTAAGGGTTCCTTCAAGTACGCCTGGG  
TTCTTGACAAGCTCAAGGCCGAGCGTGAGCGTGGTATCACCATCGATATTGCTCTCTGGAAG  
TTCGAGACTCCTCGCTACTATGTCACCGTCATTGGTATGTTGTCGCTCATGCTTCATTCTACTT  
CTCTTCGTACTAACATATCACTCAGACGCTCCCGGTCACCGTGATTCATCAAGAACATGATC

A

**CHS<sub>3</sub> ITS sequence:**

TTGGAGCGCTCGAGATTTGGCATCCACCAGACGGGGCTCTACCCTCTATGGCGTCCCG  
TTCCAGGGAACCTCGGAAGGCACCGCATCAAAAAGTATCCTCTACAAATTACAACTCGGGCCCCG

AAAGCCAGATTTCAAATTTGAGCTGTTGCCGCTTCACTCGCCGTTACTAGGGCAATCCCTGTT  
GGTTTCTTTTCTCCGCTTATTGATATGCTTAAGTTCAGCGGGTATCCTACCTGATCCGAGGT  
CAACATTCAGAAGTTGGGGTTTTACGGCATGGCCGCGCCGCGTTCAGTTGCGAGGTGTTAG  
CTACTACGCAATGGAGGCTGCAGCGAGACCGCCAATGTATTTGGGGGGCGGCACCGCCCAG  
AAGGGCAGAGCCGATCCCCAACACCAAACCCGGGGGCTTGAGGGTTGAAATGACGCTCGA  
ACAGGCATGCCCCGCCGAATACCAGCGGGCGCAATGTGCGTTCAAAGATTCGATGATTCACT  
GAATTCTGCAATTCACATACTTATCGCATTTTGCTGCGTTCTTCATCGATGCCAGAACCAAG  
AGATCCGTTGTTGAAAGTTTTGATTTATTTGTTTGTACTCAGAAGTTACAATAAGAAACA  
TTAGAGTTTGGGTCCTCTGGCGGGCCGTCCCGTTTTACGGGGCGCGGGCTGATCCGCCGAGG  
CAACATTAAGGTATGTTACAGGGGTTTGGGAGTTGTAAACTCGGTAATGATCCCTCCGCTG  
GTTACCAACGGAGACCTTGTTACGACTTTTACTTCCTCTAAATGACCGAGTTTGGAGAGCT  
TTCCGGCCCTGAGTGGTAGTTGCCACCTCTCTGGGCCAGTCCGGACGCCTCACTGAGCCAT  
TCAATCGGTAGTAGCGACGGGCGGTGTGTACATGGG

**CHS<sub>3</sub> TEF-1 $\alpha$  sequence:**

TGGCAAGTCGACCACTGTAAGTACAACCAACAGCGGGTTGCTTATCTGCACTCGGAAT  
CCGCCAAACCTGGCGGGTATCACAAAACATCTTGCTAACTTTTGACAGACCGGTCACTT  
GATCTACCAGTGCGGTGGTATCGACAAGCGAACCATCGAGAAGTTCGAGAAGGTTAGTCA  
ATATCCCTTCGATTACGCGCGCTCCCATCGATTCCCACGATTCGCTCCCTCACTCGAAACAC  
ATCCATTACCCCGCTCGAGTCCGAAAATTTGCGGTGCGACCGTGATTTTTTCTGGTGGGGT  
ATCTTACCCCGCCACTCGAGTCACGGATGCGCTTGCCCTGTTCCACAAAACCTTACCACCC  
TGTCGCGCACTACATGTCTTGCAGTCACTAACCCTGGACAATAGGAAGCCGCCGAGCTCG  
GAAAGGGTTCCTTCAAGTACGCCTGGGTTCTTGACAAGCTCAAAGCCGAGCGTGAGCGTGG

TATCACCATTGATATCGCTCTCTGGAAGTTCGAGACTCCTCGCTACTATGTCACCGTCATTC

GGTATGTTGTCACTGTCTCGACACTATCATGTGATTCATCATGCTAACATCTCTCAGATGCC

CCCGGTCATCGTGATTCATCAAGAACATG