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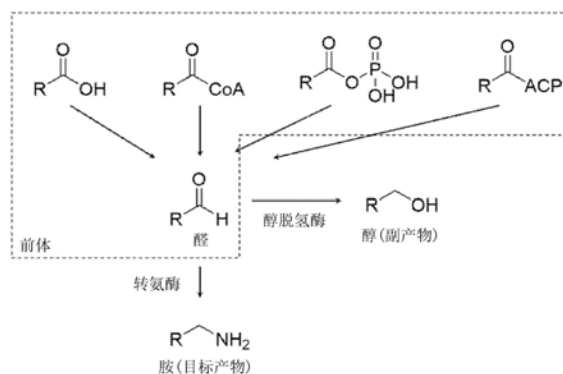
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(54) 发明名称

基因重组微生物和二胺化合物的制造方法

(57) 摘要

本发明的课题在于提供一种生产二胺化合物的微生物、以及二胺化合物的制造方法。本发明的技术手段在于一种基因重组微生物,其为表达参与二胺化合物合成的酶的微生物,其中,该二胺化合物由式: $H_2N-R-NH_2$ (式中,R为由选自自由C、H、O、N组成的组中的1个以上的原子构成的链状或环状的有机基团)表示,该基因重组微生物按照醇脱氢酶的活性与非降低株相比降低的方式进行了改变。



1. 一种基因重组微生物,其为表达参与二胺化合物合成的酶的微生物,其中,
该二胺化合物由式: $H_2N-R-NH_2$ 表示,
式中,R为由选自C、H、O、N、S组成的组中的1个以上的原子构成的链状或环状的有机基团,
该基因重组微生物按照醇脱氢酶的活性与非降低株相比降低的方式进行了改变。
2. 如权利要求1所述的基因重组微生物,其中,醇脱氢酶的活性与非降低株相比降低的改变为:
编码醇脱氢酶的基因的表达被抑制的改变;或者
编码醇脱氢酶的基因的表达被抑制、并且醇脱氢酶的活性被抑制的改变。
3. 如权利要求1或2所述的重组微生物,其中,所述醇脱氢酶为由下述DNA编码的蛋白质,所述DNA为:
 - 由选自序列号2、4、6、8、10、12、14、16、18、20、22、24、26、28、30、32、34、36、38、40、42、44、46、48、50、52、54、56、58、60、62、64、66、68、70、72、74、76、78、80、82、84、86、88、90、92、94、96、98和100中的碱基序列构成的DNA;
 - 由与选自序列号2、4、6、8、10、12、14、16、18、20、22、24、26、28、30、32、34、36、38、40、42、44、46、48、50、52、54、56、58、60、62、64、66、68、70、72、74、76、78、80、82、84、86、88、90、92、94、96、98和100中的碱基序列具有85%以上的序列同源性的碱基序列构成、并且编码具有醇脱氢酶活性的蛋白质的DNA;
 - 为编码相对于由选自序列号2、4、6、8、10、12、14、16、18、20、22、24、26、28、30、32、34、36、38、40、42、44、46、48、50、52、54、56、58、60、62、64、66、68、70、72、74、76、78、80、82、84、86、88、90、92、94、96、98和100中的碱基序列编码的蛋白质的氨基酸序列缺失、置换、插入和/或附加了1~10个氨基酸的氨基酸序列所构成的蛋白质的碱基序列,并编码具有醇脱氢酶活性的蛋白质的DNA;或
 - 由选自序列号2、4、6、8、10、12、14、16、18、20、22、24、26、28、30、32、34、36、38、40、42、44、46、48、50、52、54、56、58、60、62、64、66、68、70、72、74、76、78、80、82、84、86、88、90、92、94、96、98和100中的碱基序列的简并异构体构成的DNA。
4. 如权利要求1~3中任一项所述的重组微生物,其中,所述醇脱氢酶是具有与选自序列号1、3、5、7、9、11、13、15、17、19、21、23、25、27、29、31、33、35、37、39、41、43、45、47、49、51、53、55、57、59、61、63、65、67、69、71、73、75、77、79、81、83、85、87、89、91、93、95、97和99中的氨基酸序列具有80%以上的序列同源性的氨基酸序列、并且具有醇脱氢酶活性的蛋白质。
5. 如权利要求1~4中任一项所述的基因重组微生物,其中,所述醇脱氢酶是由选自由yqhD、fucO、adhP、ybbO、eutG、ahr、yahK、adhE、ybdR、dkgA、yiaY、frmA、dkgB、yghA、ydgJG、gldA、yohF、yeaE、ADH1、ADH2、ADH3、ADH4、ADH5、ADH6、ADH7、SFA1、AAD3、AAD4、AAD10、AAD14、AAD15、YPR1、NCg10324、NCg10313、NCg10219、NCg12709、NCg11112、NCg12382、NCg10186、NCg10099、NCg12952、NCg11459、yogA、bdhK、bdhJ、akrN、yqkF、yccK、iolS和yrrpG组成的组中的至少一种基因编码的蛋白质。
6. 如权利要求1~5中任一项所述的基因重组微生物,其中,所述醇脱氢酶是由选自由yqhD、fucO、adhP、eutG、ybbO、ahr和yahK组成的组中的至少一种基因编码的蛋白质。
7. 如权利要求1~6中任一项所述的基因重组微生物,其中,所述醇脱氢酶是由选自由

yqhD和adhP组成的组中的至少一种基因编码的蛋白质。

8. 如权利要求7所述的基因重组微生物,其中,所述醇脱氢酶是由adhP基因编码的蛋白质。

9. 如权利要求1~6中任一项所述的基因重组微生物,其中,所述醇脱氢酶是由选自由yqhD、fucO、eutG、ybbO、ahr和yahK组成的组中的至少一种基因编码的蛋白质。

10. 如权利要求9所述的基因重组微生物,其中,所述醇脱氢酶是由选自由eutG、ybbO、ahr和yahK组成的组中的至少一种基因编码的蛋白质。

11. 如权利要求1~6中任一项所述的基因重组微生物,其中,所述醇脱氢酶是由选自由yqhD、fucO、adhP、eutG、ybbO、ahr和yahK组成的组中的2种以上的基因编码的蛋白质。

12. 如权利要求1~6中任一项所述的基因重组微生物,其中,所述醇脱氢酶是由选自由
yqhD和fucO、
yqhD和adhP、
yqhD和eutG、
yqhD和ybbO、
yqhD和ahr、
yqhD和yahK、
yqhD、fucO和adhP、
yqhD、fucO、adhP和eutG、
yqhD、fucO、adhP、eutG和ybbO、
yqhD、fucO、adhP、eutG、ybbO和ahr、以及
yqhD、fucO、adhP、eutG、ybbO、ahr和yahK
组成的组中的1种组合的基因编码的蛋白质。

13. 如权利要求1~12中任一项所述的重组微生物,其中,所述醇脱氢酶的活性与非降低株相比降低的改变通过选自由下述方式组成的组中的1种以上来进行,所述方式为:

降低所述微生物内的编码所述醇脱氢酶的基因的转录量和/或翻译量;以及
破坏所述微生物内的编码所述醇脱氢酶的基因。

14. 如权利要求1~13中任一项所述的基因重组微生物,其中,所述基因重组微生物属于选自由埃希氏菌属、棒状杆菌属、芽孢杆菌属、不动杆菌属、伯克霍尔德菌属、假单胞菌属、梭菌属、酵母菌属、裂殖酵母属、耶氏酵母属、念珠菌属、毕赤酵母属和曲霉属组成的组中的属。

15. 如权利要求1~14中任一项所述的基因重组微生物,其中,所述基因重组微生物为大肠杆菌(*Escherichia coli*)。

16. 如权利要求1~15中任一项所述的基因重组微生物,其表达转氨酶作为所述参与二胺化合物合成的酶。

17. 如权利要求1~16中任一项所述的基因重组微生物,其表达羧酸还原酶作为所述参与二胺化合物合成的酶。

18. 如权利要求17所述的基因重组微生物,其中,所述羧酸还原酶具有将羧酸半醛、二羧酸、或者氨基酸的羧基转换成醛的活性。

19. 如权利要求1~18中任一项所述的基因重组微生物,其特征在于,

具有产生二羧酸、羧酸半醛、或者氨基酸的能力，
进一步表达转氨酶和羧酸还原酶。

20. 如权利要求1~19中任一项所述的基因重组微生物，其特征在于，
具有产生己二酸、己二酸半醛、或者6-氨基己酸的能力，
进一步表达转氨酶和羧酸还原酶。

21. 如权利要求17~20中任一项所述的基因重组微生物，其中，进一步进行了增大磷酸泛酰巯基乙胺基转移酶的活性的改变。

22. 如权利要求16~21中任一项所述的基因重组微生物，其中，编码所述转氨酶的基因为 $ygjG$ 。

23. 如权利要求17~22中任一项所述的基因重组微生物，其中，编码所述羧酸还原酶的基因为 $MaCar$ 。

24. 如权利要求21~23中任一项所述的基因重组微生物，其中，编码所述磷酸泛酰巯基乙胺基转移酶的基因为 Npt 。

25. 如权利要求1~24中任一项所述的重组微生物，其包含与序列号115所示的碱基序列具有85%以上的序列同源性、并且编码具有转氨酶活性的蛋白质的碱基序列，或者，

包含与编码序列号110~114中的任一者所示的氨基酸序列的碱基序列具有85%以上的序列同源性、并且编码具有转氨酶活性的蛋白质的碱基序列。

26. 如权利要求1~25中任一项所述的重组微生物，其包含与序列号105所示的碱基序列具有85%以上的序列同源性、并且编码具有羧酸还原酶活性的蛋白质的碱基序列，或者，

包含与编码序列号101~104中的任一者所示的氨基酸序列的碱基序列具有85%以上的序列同源性、并且编码具有羧酸还原酶活性的蛋白质的碱基序列。

27. 如权利要求21~26中任一项所述的重组微生物，其包含与序列号109所示的碱基序列具有85%以上的序列同源性、并且编码具有磷酸泛酰巯基乙胺基转移酶活性的蛋白质的碱基序列，或者，

包含与编码序列号106~108中的任一者所示的氨基酸序列的碱基序列具有80%以上的序列同源性、并且编码具有磷酸泛酰巯基乙胺基转移酶活性的蛋白质的碱基序列。

28. 如权利要求1~27中任一项所述的基因重组微生物，其表达选自自由

酰基- (酰基载体蛋白 (ACP)) 还原酶 (AAR)、

由酰基CoA生产醛的酶、和

由酰基磷酸生成醛的酶

组成的组中的1种以上的酶。

29. 一种二胺化合物的制造方法，其使用了权利要求1~28中任一项所述的基因重组微生物。

30. 一种二胺化合物的制造方法，其包括：

培养工序，在含有碳源和氮源的培养基中培养权利要求1~28中任一项所述的基因重组微生物，得到包含菌体的培养液。

31. 如权利要求30所述的二胺化合物的制造方法，其中，

所述培养基进一步包含二胺化合物的前体，或者，

在所述培养工序中，包括向所述培养基中添加所述前体的步骤。

32. 如权利要求30或31所述的二胺化合物的制造方法,其包括:

反应工序,使所述培养液和/或所述菌体与含有二胺化合物的前体的水溶液接触,得到包含二胺化合物的反应液。

33. 如权利要求31或32所述的二胺化合物的制造方法,其中,所述前体选自由二羧酸、羧酸半醛、氨基羧酸、氨基醛、二醛、酰基-ACP、酰基-CoA和酰基磷酸组成的组中。

基因重组微生物和二胺化合物的制造方法

技术领域

[0001] 本发明涉及生产二胺化合物的基因重组微生物和二胺化合物的制造方法。

背景技术

[0002] 二胺化合物作为以聚酰胺树脂为首的高分子的原料等被广泛利用。作为工业上利用的二胺化合物,代表性的化合物可以举出六亚甲基二胺(1,6-二氨基己烷)、七亚甲基二胺(1,7-二氨基庚烷)、八亚甲基二胺(1,8-二氨基辛烷)、十亚甲基二胺(1,10-二氨基癸烷)、十二亚甲基二胺(1,12-二氨基十二烷)等。

[0003] 例如,六亚甲基二胺是通过丁二烯的氢化氰化、丙烯腈的电解二聚、或者己二酸的腈化得到己二腈,进而通过以镍等为催化剂的氢化而合成的。(非专利文献1)工业上通过本方法生产六亚甲基二胺,暂且进行了己二腈的合成后,进行氢化反应。另外,对于癸二胺、辛二胺、十二烷二胺等,与上述己二酸原料同样地,已知得到对应的二腈并通过氢化进行合成的方法。(专利文献1、2)

[0004] 近年来,在化学产品制造工艺中,希望从担心枯竭、并且被认为是地球温室化的原因之一的化石燃料来源的原料转换成生物质来源等可再生的原料。针对本课题,关于1,3-二氨基丙烷(非专利文献2)、1,4-二氨基丁烷、1,5-二氨基戊烷(非专利文献3)、4-氨基苯基乙胺(非专利文献4)等二胺化合物,公开了使用通过基因重组改变了代谢的微生物的制造方法。

[0005] 其中,利用基因重组微生物由细胞内的二羧酸、氨基酸、二醛等并组合外来酶(例如羧酸脱羧酶、转氨酶)来生成二胺的方法中,作为底物的化合物的适用性广泛,例如报道了六亚甲基二胺(专利文献3、4)、七亚甲基二胺(专利文献5)。

[0006] 专利文献3中,基于经由电脑模拟的代谢模拟预测、例示出了一种酶基因,该酶基因在以具有六亚甲基二胺生产路径的方式进行了改变的微生物宿主中通过缺失或破坏预期提高收率。但是,关于来自六亚甲基二胺生产路径中的中间体的副产物及其抑制方法,完全没有提及。

[0007] 专利文献4记载了通过经由6-羟基己酸的酶反应路径来生产六亚甲基二胺的方法。但是,关于通过基因重组新构建的六亚甲基二胺生产路径中的中间体来源的副产物的生成及其抑制方法,尚未提及。

[0008] 专利文献5记载了利用经由庚二酸等的酶反应路径来生产七亚甲基二胺的方法。但是,关于来自反应路径中的中间体的副产物的生成及其抑制方法,尚未提及。

[0009] 因此,在现有技术中,关于起因于转换为二胺化合物的路径的副产物的生成及其抑制方法没有任何公开。在利用基因重组微生物的二胺化合物生产中,需要能更有效地抑制副产物、有效地生产二胺化合物的技术。

[0010] 现有技术文献

[0011] 专利文献

[0012] 专利文献1:日本特开昭57-70842号公报

- [0013] 专利文献2:日本特公昭49-24446号公报
- [0014] 专利文献3:日本特开2015-146810号公报
- [0015] 专利文献4:日本特开2017-544854号公报
- [0016] 专利文献5:日本特表2014-525741号公报
- [0017] 非专利文献
- [0018] 非专利文献1:Process Economics Program Report 31B(IHS market)
- [0019] 非专利文献2:Chae,T.et al.,Metabolic engineering of Escherichia coli for the production of 1,3-diaminopropane,a three carbon diamine.,Sci Rep.2015 Aug 11;5:13040
- [0020] 非专利文献3:Tsuge,Y.et al.,Engineering cell factories for producing building block chemicals for bio-polymer synthesis.,Microb.Cell Fact.,Vol., 15,19 (2016)
- [0021] 非专利文献4:Masuo,S.,et al,Bacterial fermentation platform for producing artificial aromatic amines.,Scientific Reports volume 6, Articlenumber:25764 (2016)

发明内容

- [0022] 发明所要解决的课题
- [0023] 本发明的课题在于提供一种生产二胺化合物的微生物、以及二胺化合物的制造方法。
- [0024] 用于解决课题的手段
- [0025] 本发明人在研究过程中发现,在具有二胺化合物生产路径的微生物中,根据内源性的醇脱氢酶活性,会生成来自二胺生物合成路径中间体的副产物醇体。本发明人进行了深入研究,结果发现,通过以降低宿主微生物的醇脱氢酶活性的方式进行改变,能够抑制作为副产物的醇体的生成和/或能够提高二胺化合物的生成量,由此完成了本发明。
- [0026] 即,本发明提供下述方案。
- [0027] [1]一种基因重组微生物,其为表达参与二胺化合物合成的酶的微生物,其中,
- [0028] 该二胺化合物由式: $H_2N-R-NH_2$
- [0029] (式中,R为由选自由C、H、O、N、S组成的组中的1个以上的原子构成的链状或环状的有机基团。)表示,
- [0030] 该基因重组微生物按照醇脱氢酶的活性与非降低株相比降低的方式进行了改变;
- [0031] [2]如[1]所述的基因重组微生物,其中,醇脱氢酶的活性与非降低株相比降低的改变为:
- [0032] 编码醇脱氢酶的基因的表达被抑制的改变;或者
- [0033] 编码醇脱氢酶的基因的表达被抑制、并且醇脱氢酶的活性被抑制的改变;
- [0034] [3]如[1]或[2]所述的重组微生物,其中,上述醇脱氢酶为由下述DNA编码的蛋白质,上述DNA为:
- [0035] • 由选自序列号2、4、6、8、10、12、14、16、18、20、22、24、26、28、30、32、34、36、38、40、42、44、46、48、50、52、54、56、58、60、62、64、66、68、70、72、74、76、78、80、82、84、86、88、

90、92、94、96、98和100中的碱基序列构成的DNA；

[0036] • 由与选自序列号2、4、6、8、10、12、14、16、18、20、22、24、26、28、30、32、34、36、38、40、42、44、46、48、50、52、54、56、58、60、62、64、66、68、70、72、74、76、78、80、82、84、86、88、90、92、94、96、98和100中的碱基序列具有85%以上的序列同源性的碱基序列构成、并且编码具有醇脱氢酶活性的蛋白质的DNA；

[0037] • 为编码相对于由选自序列号2、4、6、8、10、12、14、16、18、20、22、24、26、28、30、32、34、36、38、40、42、44、46、48、50、52、54、56、58、60、62、64、66、68、70、72、74、76、78、80、82、84、86、88、90、92、94、96、98和100中的碱基序列编码的蛋白质的氨基酸序列缺失、置换、插入和/或附加了1~10个氨基酸的氨基酸序列所构成的蛋白质的碱基序列，并编码具有醇脱氢酶活性的蛋白质的DNA；或

[0038] • 由选自序列号2、4、6、8、10、12、14、16、18、20、22、24、26、28、30、32、34、36、38、40、42、44、46、48、50、52、54、56、58、60、62、64、66、68、70、72、74、76、78、80、82、84、86、88、90、92、94、96、98和100中的碱基序列的简并异构体构成的DNA；

[0039] [4]如[1]~[3]中任一项所述的重组微生物，其中，上述醇脱氢酶是具有与选自序列号1、3、5、7、9、11、13、15、17、19、21、23、25、27、29、31、33、35、37、39、41、43、45、47、49、51、53、55、57、59、61、63、65、67、69、71、73、75、77、79、81、83、85、87、89、91、93、95、97和99中的氨基酸序列具有80%以上的序列同源性的氨基酸序列、并且具有醇脱氢酶活性的蛋白质；

[0040] [5]如[1]~[4]中任一项所述的基因重组微生物，其中，上述醇脱氢酶是由选自由 yqhD、fucO、adhP、ybbO、eutG、ahr、yahK、adhE、ybdR、dkgA、yiaY、frmA、dkgB、yghA、ydjG、gldA、yohF、yeaE、ADH1、ADH2、ADH3、ADH4、ADH5、ADH6、ADH7、SFA1、AAD3、AAD4、AAD10、AAD14、AAD15、YPR1、NCg10324、NCg10313、NCg10219、NCg12709、NCg11112、NCg12382、NCg10186、NCg10099、NCg12952、NCg11459、yogA、bdhK、bdhJ、akrN、yqkF、yccK、iolS和yrpG组成的组中的至少一种基因编码的蛋白质；

[0041] [6]如[1]~[5]中任一项所述的基因重组微生物，其中，上述醇脱氢酶是由选自由 yqhD、fucO、adhP、eutG、ybbO、ahr、yahK组成的组中的至少一种基因编码的蛋白质；

[0042] [7]如[1]~[6]中任一项所述的基因重组微生物，其中，上述醇脱氢酶是由选自由 yqhD和adhP组成的组中的至少一种基因编码的蛋白质；

[0043] [8]如[7]所述的基因重组微生物，其中，上述醇脱氢酶是由adhP基因编码的蛋白质；

[0044] [9]如[1]~[6]中任一项所述的基因重组微生物，其中，上述醇脱氢酶是由选自由 yqhD、fucO、eutG、ybbO、ahr和yahK组成的组中的至少一种基因编码的蛋白质；

[0045] [10]如[9]所述的基因重组微生物，其中，上述醇脱氢酶是由选自由eutG、ybbO、ahr和yahK组成的组中的至少一种基因编码的蛋白质；

[0046] [11]如[1]~[6]中任一项所述的基因重组微生物，其中，上述醇脱氢酶是由选自由 yqhD、fucO、adhP、eutG、ybbO、ahr和yahK组成的组中的2种以上的基因编码的蛋白质；

[0047] [12]如[1]~[6]中任一项所述的基因重组微生物，其中，上述醇脱氢酶是由选自由

[0048] yqhD和fucO、

[0049] yqhD和adhP、

- [0050] yqhD和eutG、
- [0051] yqhD和ybb0、
- [0052] yqhD和ahr、
- [0053] yqhD和yahK、
- [0054] yqhD、fuc0和adhP、
- [0055] yqhD、fuc0、adhP和eutG、
- [0056] yqhD、fuc0、adhP、eutG和ybb0、
- [0057] yqhD、fuc0、adhP、eutG、ybb0和ahr、以及
- [0058] yqhD、fuc0、adhP、eutG、ybb0、ahr和yahK
- [0059] 组成的组中的1种组合的基因编码的蛋白质；
- [0060] [13]如[1]～[12]中任一项所述的重组微生物，其中，上述醇脱氢酶的活性与非降低株相比降低的改变通过选自由下述方式组成的组中的1种以上来进行，上述方式为：
- [0061] 降低上述微生物内的编码上述醇脱氢酶的基因的转录量和/或翻译量；以及破坏上述微生物内的编码上述醇脱氢酶的基因；
- [0062] [14]如[1]～[13]中任一项所述的基因重组微生物，其中，上述基因重组微生物属于选自由埃希氏菌属、棒状杆菌属、芽孢杆菌属、不动杆菌属、伯克霍尔德菌属、假单胞菌属、梭菌属、酵母菌属、裂殖酵母属、耶氏酵母属、念珠菌属、毕赤酵母属和曲霉属组成的组中的属；
- [0063] [15]如[1]～[14]中任一项所述的基因重组微生物，其中，上述基因重组微生物为大肠杆菌 (*Escherichia coli*)；
- [0064] [16]如[1]～[15]中任一项所述的基因重组微生物，其表达转氨酶作为上述参与二胺化合物合成的酶；
- [0065] [17]如[1]～[16]中任一项所述的基因重组微生物，其表达羧酸还原酶作为上述参与二胺化合物合成的酶；
- [0066] [18]如[17]所述的基因重组微生物，其中，上述羧酸还原酶具有将羧酸半醛、二羧酸、或者氨基酸的羧基转换成醛的活性；
- [0067] [19]如[1]～[18]中任一项所述的基因重组微生物，其特征在于，
- [0068] 具有产生二羧酸、羧酸半醛、或者氨基酸的能力，
- [0069] 进一步表达转氨酶和羧酸还原酶；
- [0070] [20]如[1]～[19]中任一项所述的基因重组微生物，其特征在于，
- [0071] 具有产生己二酸、己二酸半醛、或者6-氨基己酸的能力，
- [0072] 进一步表达转氨酶和羧酸还原酶；
- [0073] [21]如[11]～[20]中任一项所述的基因重组微生物，其中，进一步进行了增大磷酸泛酰巯基乙胺基转移酶的活性的改变；
- [0074] [22]如[16]～[21]中任一项所述的基因重组微生物，其中，编码上述转氨酶的基因为ygjG；
- [0075] [23]如[17]～[22]中任一项所述的基因重组微生物，其中，编码上述羧酸还原酶的基因为MaCar；
- [0076] [24]如[21]～[23]中任一项所述的基因重组微生物，其中，编码上述磷酸泛酰巯

基乙胺基转移酶的基因为Npt;

[0077] [25]如[1]~[24]中任一项所述的重组微生物,其包含与序列号115所示的碱基序列具有85%以上的序列同源性、并且编码具有转氨酶活性的蛋白质的碱基序列,或者,

[0078] 包含与编码序列号110~114中的任一者所示的氨基酸序列的碱基序列具有85%以上的序列同源性、并且编码具有转氨酶活性的蛋白质的碱基序列;

[0079] [26]如[1]~[25]中任一项所述的重组微生物,其包含与序列号105所示的碱基序列具有85%以上的序列同源性、并且编码具有羧酸还原酶活性的蛋白质的碱基序列,或者,

[0080] 包含与编码序列号101~104中的任一者所示的氨基酸序列的碱基序列具有85%以上的序列同源性、并且编码具有羧酸还原酶活性的蛋白质的碱基序列;

[0081] [27]如[21]~[26]中任一项所述的重组微生物,其包含与序列号109所示的碱基序列具有85%以上的序列同源性、并且编码具有磷酸泛酰巯基乙胺基转移酶活性的蛋白质的碱基序列,或者,

[0082] 包含与编码序列号106~108中的任一者所示的氨基酸序列的碱基序列具有80%以上的序列同源性、并且编码具有磷酸泛酰巯基乙胺基转移酶活性的蛋白质的碱基序列;

[0083] [28]如[1]~[27]中任一项所述的基因重组微生物,其表达选自由

[0084] 酰基-(酰基载体蛋白(ACP))还原酶(AAR)、

[0085] 由酰基CoA生产醛的酶、和

[0086] 由酰基磷酸生成醛的酶

[0087] 组成的组中的1种以上的酶;

[0088] [29]一种二胺化合物的制造方法,其使用了[1]~[28]中任一项所述的基因重组微生物;

[0089] [30]一种二胺化合物的制造方法,其包括:

[0090] 培养工序,在含有碳源和氮源的培养基中培养[1]~[28]中任一项所述的基因重组微生物,得到包含菌体的培养液;

[0091] [31]如[30]所述的二胺化合物的制造方法,其中,

[0092] 上述培养基进一步包含二胺化合物的前体,或者,

[0093] 在上述培养工序中,包括向上述培养基中添加上述前体的步骤;

[0094] [32]如[30]或[31]所述的二胺化合物的制造方法,其包括:

[0095] 反应工序,使上述培养液和/或上述菌体与含有二胺化合物的前体的水溶液接触,得到包含二胺化合物的反应液;

[0096] [33]如[31]或[32]所述的二胺化合物的制造方法,其中,上述前体选自由二羧酸、羧酸半醛、氨基羧酸、氨基醛、二醛、酰基-ACP、酰基-CoA和酰基磷酸组成的组中。

[0097] 发明的效果

[0098] 通过本发明,能够生产二胺化合物。

附图说明

[0099] 图1中,作为本发明的基因重组微生物中的二胺化合物的生产路径例,示意性地示出由各种前体向胺的官能团转换。

[0100] 图2示出利用含1,6-己二醇的培养基将破坏了ADH基因的大肠杆菌株培养48小时

后的培养上清中的1,6-己二醇浓度。

[0101] 图3是pDA56的质粒图。图中,“lacI”表示lacI基因,“T7 Promoter”表示T7启动子,“T7 Terminator”表示T7终止子,“ygjG”表示大肠杆菌 (*Escherichia coli*) 来源的ygjG基因,“MaCar”表示脓肿分枝杆菌 (*Mycobacterium abscessus*) 来源的羧酸还原酶基因,“Npt”表示艾阿华诺卡氏菌 (*Nocardia iowensis*) 来源的磷酸泛酰巯基乙胺基转移酶基因,“CAT”表示氯霉素乙酰基转移酶基因,“P15Aori”表示复制起点。

具体实施方式

[0102] 以下,对本发明的实施方式进行详细说明。

[0103] 本发明的基因重组微生物是具有二胺化合物生产路径、进而按照醇脱氢酶活性降低的方式进行了改变的基因重组微生物。此处,改变包括碱基的置换、缺失、插入和/或附加。以下,将“基因重组微生物”也简称为“重组微生物”。

[0104] 上述重组微生物表达参与二胺化合物合成的酶或参与二胺化合物合成的酶组。作为参与二胺化合物合成的酶,可以举出例如羧酸还原酶和转氨酶。如图1所示,羧酸还原酶例如具有将羧酸半醛、二羧酸、或者氨基酸的羧基转换成醛的活性。如图1所示,转氨酶具有将醛转换成胺的活性。本发明中,对于微生物来说,“表达参与二胺化合物合成的酶或参与二胺化合物合成的酶组”是指,宿主微生物本身可以具有表达该酶或酶组的能力,或者,可以对宿主微生物进行了表达该酶或酶组的改变。

[0105] 本发明中的“二胺化合物”(以下也简称为“二胺”)由式: $H_2N-R-NH_2$ 表示。式中,R为由选自C、H、O、N、S组成的组中的1个以上的原子构成的链状或环状的2价有机基团。链状的有机基团包括直链的有机基团和支链的有机基团。环状的有机基团包括脂环式的有机基团、杂环式的有机基团、其他环式的有机基团和芳香族的有机基团。

[0106] 作为构成R的有机基团,可以举出例如亚甲基、亚乙基、亚乙烯基、三亚甲基、亚丙基、亚丙烯基、四亚甲基、亚异丁基、五亚甲基、六亚甲基、八亚甲基等脂肪族烃基、亚环丁基、亚环戊基、亚环己基、亚环庚基、亚环辛基、亚环己烯基、亚环己二烯基等脂环式烃基、邻亚苯基、间亚苯基、对亚苯基、二亚苯基、亚萘基、1,2-亚苯基二亚甲基、1,3-亚苯基二亚甲基、1,4-亚苯基二亚甲基、1,4-亚苯基二亚乙基、亚甲基二亚苯基、亚乙基二亚苯基等芳香族烃基、氧基、羰基等包含氧的特性基团、亚甲基二氧基、亚乙基二氧基等醚基、草酰基、丙二酰基、琥珀酰基、戊二酰基、己二酰基、辛二酰基、邻苯二甲酰基、间苯二甲酰基、对苯二甲酰基等酰基、巯基、硫代羰基等含硫的特性基团、亚氨基、偶氮基等含氮的特性基团、以及基于它们的组合的基团,但不限于此。

[0107] 另外,R可以包含1个以上的取代基。作为R可包含的取代基,可以举出例如氨基、羧基、氰基、硝基、羟基、巯基等,但不限于此。

[0108] 在一个方式中,R为链状和环状的烃,链状的烃包括直链以及支链的饱和及不饱和的烃。在一个优选方式中,R是碳原子数为3~20的烃基。更优选R是式: $CH_2(CH_2)_nCH_2$ 所示的直链饱和烃基,式中,n为1、2、3、4、5、6、7、8、9或10。进一步优选n为2、3、4、5、6、7或8,特别优选n为4、5、6、7或8。

[0109] 作为典型的二胺化合物,可以举出1,3-二氨基丙烷(三亚甲基二胺)、1,4-二氨基丁烷(四亚甲基二胺、腐胺)、1,5-二氨基戊烷(五亚甲基二胺、尸胺)、1,6-二氨基己烷(六亚

甲基二胺)、1,7-二氨基庚烷(七亚甲基二胺)、1,8-二氨基辛烷(八亚甲基二胺)、1,9-二氨基壬烷(九亚甲基二胺)、1,10-二氨基癸烷(十亚甲基二胺)、1,11-二氨基十一烷(十一亚甲基二胺)、1,12-二氨基十二烷(十二亚甲基二胺)、3-氨基苄胺、4-氨基苄胺、2-甲基五亚甲基二胺、2-甲基五亚甲基二胺、2,2,4-三甲基六亚甲基二胺、2,4,4-三甲基六亚甲基二胺、1,3-双(氨基甲基)环己烷、1,4-双(氨基甲基)环己烷、间二甲苯二胺、对二甲苯二胺、1-氨基-3-氨基甲基-3,5,5-三甲基环己烷、双(4-氨基环己基)甲烷、双(4-氨基-3-甲基环己基)甲烷、1,4-双(氨基丙基)哌嗪、1,3-二氨基环己烷、1,4-二氨基环己烷、1,3-苯二胺、1,4-苯二胺、N-(3-氨基丙基)1,4-丁二胺(亚精胺)、3,3'-二氨基二丙胺、N,N-双(3-氨基丙基)甲烷、N,N'-双(3-氨基丙基)乙二胺、N,N'-双(2-氨基乙基)-1,3-丙二胺、N,N'-双(3-氨基丙基)-1,4-丁二胺(精胺)、2,2'-二硫代双(乙胺)、二亚丙基三胺等,但不限于此。本领域技术人员可理解的是,二胺为包括任意的盐形式的中性或电离型的形式,该形式取决于pH。

[0110] 本说明书中的“二羧酸”是指具有化学式 HOOC-R-COOH (式中,R如上所述)所示的结构的化合物。二羧酸包括脂肪族二羧酸和芳香族羧酸。作为典型的二羧酸,可以举出草酸、丙二酸、琥珀酸、富马酸、衣康酸、戊二酸、己二酸、粘康酸、庚二酸、辛二酸、壬二酸、癸二酸、十二烷二酸、苹果酸、2,5-呋喃二甲酸、邻苯二甲酸、间苯二甲酸、对苯二甲酸、马来酸、酒石酸、粘康酸等,但不限于此。本领域技术人员可理解的是,二羧酸为包括任意的盐形式的中性或电离型的形式,该形式取决于pH。

[0111] 本说明书中的“羧酸半醛”是指具有化学式 HOOC-R-CHO (式中,R如上所述)所示的结构的化合物。作为典型的羧酸半醛,可以举出琥珀酸半醛、戊二酸半醛、己二酸半醛、庚二酸半醛、辛二酸半醛、壬二酸半醛、癸二酸半醛等,但不限于此。本领域技术人员可理解的是,羧酸半醛为包括任意的盐形式的中性或电离型的形式,该形式取决于pH。

[0112] 本说明书中的“氨基酸”是指具有化学式 $\text{H}_2\text{N-R-COOH}$ (式中,R如上所述)所示的结构的化合物。作为典型的氨基酸,可以举出甘氨酸、 β -丙氨酸、4-氨基丁酸、5-氨基戊酸、6-氨基己酸、7-氨基庚酸、8-氨基辛酸、9-氨基壬酸、10-氨基癸酸、12-氨基十二酸等,但不限于此。本领域技术人员可理解的是,氨基酸为包括任意的盐形式的中性或电离型的形式,该形式取决于pH。

[0113] 本说明书中,术语“内源”或“内源性”用于表示“宿主微生物是具有的”的含义,无论未通过基因重组进行改变的宿主微生物以在该宿主细胞内可进行优越的生物化学反应的程度功能性地表达出了所提及的基因或由该基因编码的蛋白质(典型地为酶)与否。

[0114] 本说明书中,术语“外来”或“外来性”用于表示在下述情况下将基于本发明的基因或核酸序列导入宿主中的含义:在基因重组前的宿主微生物不具有应当由本发明引入的基因的情况;未实质地表达基于该基因的酶的情况;以及虽然由不同的基因编码该酶的氨基酸序列、但在基因重组后不表达所匹配的内源性酶活性的情况。术语“外来性”和“外源性”在本说明书中可互换使用。

[0115] 图1中示出本发明中的二胺化合物的合成路径的官能团转换的示例。以能够衍生成醛的化合物和/或醛作为前体,合成二胺。醛通过转氨酶而转换成胺。本发明的基因重组微生物通过按照醇脱氢酶的活性降低的方式进行了改变,可抑制路径中的作为中间体的醛向醇转换。此处,醇脱氢酶包括具有醇脱氢酶活性的1种或复数种蛋白质。

[0116] 本发明中使用的宿主微生物没有特别限定,可以为原核生物、真核生物中的任一

种。已经分离保存的微生物、由天然新分离的微生物、经基因改变的微生物、按照能够代谢上述化合物的方式进行了改变的微生物等均可任意选择。可以举出例如大肠杆菌(大肠杆菌、*Escherichia coli*)等埃希氏菌属、恶臭假单胞菌(*Pseudomonas putida*)等假单胞菌属、枯草杆菌(*Bacillus subtilis*)等芽孢杆菌属、棒状杆菌(*Corynebacterium glutamicum*)等棒状杆菌属、丙酮丁醇梭菌(*Clostridium acetobutylicum*)等梭菌属、不动杆菌属、伯克霍尔德菌属的细菌、酿酒酵母(*Saccharomyces cerevisiae*)等酵母菌属、粟酒裂殖酵母(*Schizosaccharomyces pombe*)等裂殖酵母属、巴斯德毕赤酵母(*Pichia pastoris*)等毕赤酵母属、解脂耶氏酵母(*Yarrowia lipolytica*)等耶氏酵母属的酵母、米曲霉(*Aspergillus oryzae*)等曲霉属的丝状菌等,但不限于此。本发明中,优选使用大肠杆菌作为宿主微生物。

[0117] 本发明中的基因重组微生物按照与非降低株相比内源性的醇脱氢酶(Alcohol Dehydrogenase; ADH)活性降低的方式进一步进行了改变。本发明人发现,在具有二胺化合物生产路径的宿主微生物中,通过内源性的醇脱氢酶活性,会生成来自二胺生物合成路径中间体的副产物醇体,进一步深入研究的结果发现,通过按照醇脱氢酶的活性与非降低株相比降低的方式对宿主微生物进行改变,能够抑制作为副产物的醇体的生成和/或能够提高二胺化合物的生成量,由此能够有效地生产二胺化合物。

[0118] 醇脱氢酶是具有在给电子体的存在下还原醛、酮并转换成醇的活性的酶。此处,醇脱氢酶也包括下述蛋白质,该蛋白质包含在该酶的氨基酸序列中缺失、置换、插入和/或附加了1个或复数个氨基酸的氨基酸序列,是与该酶在功能上同等的蛋白质。此处,“在功能上同等的蛋白质”是指具备与该酶的活性同样的活性的蛋白质。例如,“在功能上同等的蛋白质”包括与该酶的氨基酸序列具有80%、85%、90%、95%、97%、98%或99%以上的序列同源性的蛋白质。具体而言,术语“醇脱氢酶”包含下述蛋白质:具有与下述特定的序列号所示的氨基酸序列具有80%、85%、90%、95%、97%、98%或99%以上的序列同源性的氨基酸序列,并且具有醇脱氢酶活性。

[0119] 编码醇脱氢酶的基因包含下述DNA:

[0120] • 由下述特定的序列号所示的碱基序列构成的DNA;

[0121] • 和具有与下述特定的序列号所示的碱基序列互补的碱基序列的DNA在严格条件下杂交,并且编码具有醇脱氢酶活性的蛋白质的DNA;

[0122] • 由与下述特定的序列号所示的碱基序列具有85%、90%、95%、97%、98%或99%以上的序列同源性的碱基序列构成,并且编码具有醇脱氢酶活性的蛋白质的DNA;

[0123] • 为编码相对于由下述特定的序列号所示的碱基序列编码的蛋白质的氨基酸序列缺失、置换、插入和/或附加了1个或复数个(例如1~10个、优选为1~7个、进一步优选为1~5个、进一步优选为1~3个、进一步优选为1个或2个)的氨基酸的氨基酸序列所构成的蛋白质的碱基序列,并编码具有醇脱氢酶活性的蛋白质的DNA;和

[0124] • 由下述特定的序列号所示的碱基序列的简并异构体构成的DNA。

[0125] “严格条件”是指例如“1×SSC、0.1%SDS、60℃”程度的条件,更严格的条件是指“0.1×SSC、0.1%SDS、60℃”程度的条件,进一步严格的条件是指“0.1×SSC、0.1%SDS、68℃”程度的条件。

[0126] 在本发明的一个优选方式中,醇脱氢酶包括由EC1.1.1.m(此处,m为1以上的整数)

所示的酶。作为醇脱氢酶,可以举出例如分类为EC1.1.1.1、EC1.1.1.2、EC1.1.1.71的酶,但不限定于此。

[0127] 作为醇脱氢酶,例如若为大肠杆菌,可以举出由yqhD、fuc0、adhP、ybb0、eutG、ahr、yahK、adhE、ybdR、dkgA、yiaY、frmA、dkgB、yghA、ydjG、gldA、yohF和yeaE基因编码的蛋白质。

[0128] 若为酿酒酵母(*Saccharomyces cerevisiae*),可以举出由ADH1、ADH2、ADH3、ADH4、ADH5、ADH6、ADH7、SFA1、AAD3、AAD4、AAD10、AAD14、AAD15和YPR1基因编码的蛋白质,若为棒状杆菌(*Corynebacterium glutamicum*),可以举出由NCg10324、NCg10313、NCg10219、NCg12709、NCg11112、NCg12382、NCg10186、NCg10099、NCg12952和NCg11459基因编码的蛋白质,若为枯草杆菌(*Bacillus subtilis*),可以举出由yogA、bdhK、bdhJ、akrN、yqkF、yccK、iolS和yrrpG基因编码的蛋白质,但只要具有醇脱氢酶活性则不局限于此。

[0129] 醇脱氢酶是例如由选自自由yqhD、fuc0、adhP、eutG、ybb0、ahr和yahK组成的组中的至少一种基因编码的蛋白质。对于选自上述基因组成的组中的至少一种基因,按照醇脱氢酶的活性与非降低株相比降低的方式进行改变,由此能够抑制作为副产物的醇体的生成,和/或提高二胺化合物的生成量,有效地生产二胺化合物。

[0130] 醇脱氢酶优选由选自自由yqhD、fuc0、adhP、ybb0、eutG、ahr和yahK基因组成的组中的至少一种基因编码,更优选由选自自由yqhD、ahr和yahK基因组成的组中的至少一种基因编码,进一步优选由选自自由ahr和yahK基因组成的组中的至少一种基因编码。

[0131] 醇脱氢酶优选由选自自由yqhD和adhP组成的组中的至少一种基因编码,更优选由adhP基因编码。按照降低活性的方式对这些基因中的至少一个进行改变,由此,基因重组微生物能够在二胺化合物的制造中增加二胺化合物的生成量。

[0132] 醇脱氢酶优选由选自自由yqhD、fuc0、eutG、ybb0、ahr和yahK组成的组中的至少一种基因编码,更优选由选自自由eutG、ybb0、ahr和yahK组成的组中的至少一种基因编码。按照降低活性的方式对这些基因中的至少一个进行改变,由此,基因重组微生物能够在二胺化合物的制造中抑制作为副产物的醇体的生成。

[0133] 上述醇脱氢酶优选由选自自由yqhD、fuc0、adhP、eutG、ybb0、ahr和yahK组成的组中的2种以上的基因编码,更优选由yqhD基因和选自自由fuc0、adhP、eutG、ybb0、ahr和yahK组成的组中的1种以上的基因编码。按照降低这些基因中的2种以上的活性的方式进行改变,由此,基因重组微生物能够在二胺化合物的制造中显著提高二胺化合物的生成量,同时能够抑制作为副产物的醇体的生成。

[0134] 醇脱氢酶优选由选自自由

[0135] • yqhD和fuc0、

[0136] • yqhD和adhP、

[0137] • yqhD和eutG、

[0138] • yqhD和ybb0、

[0139] • yqhD和ahr、

[0140] • yqhD和yahK、

[0141] • yqhD、fuc0和adhP、

[0142] • yqhD、fuc0、adhP和eutG、

[0143] • yqhD、fuc0、adhP、eutG和ybb0、

[0144] • yqhD、fucO、adhP、eutG、ybbO和ahr、以及

[0145] • yqhD、fucO、adhP、eutG、ybbO、ahr和yahK

[0146] 组成的组中的1种组合的基因编码。这样,通过按照降低2种以上的基因的活性的方式进行改变,基因重组微生物能够在二胺化合物的制造中更显著地提高二胺化合物的生成量,同时能够显著地抑制作为副产物的醇体的生成。

[0147] 将上述醇脱氢酶基因所编码的典型的蛋白质的氨基酸序列、和编码区的碱基序列示于下述表1-1~1-50中。需要说明的是,在各表的第1行示出基因和蛋白质名、登录号、来源。

[0148] 【表1-1】

[0149]

yqhD / ACT44688.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MNNFNLHTPTRILFGKGAIAGLREQIPHDARVLITYGGGSVKKTG VLDQVLDALKGMDVLEFGGIEPNPAYETLMNAVKLVREQKVTFL AVGGGSVLDGTFKIAAANYPENIDPWHILQTGGKEIKSAIPMGC VLTLPATGSESNAGAVISRKTGTGDKQAFHSAHVQPVFAVLDPVYTY TLPPRQVANGVVDAFVHTVEQYVTKPVDAAKIQRFAEGILLTLIED GPKALKEPENYDVRANVMWAATQALNGLIGAGVPQDWATHMLG HELTAMHGLDHAQTLAIVLPALWNEKRDTKRAKLLQYAERVWNI TEGSDDERIDAAIAATRNFEEQLGVPTHLSDYGLDGSSIPALLKKL EEHGMTQLGENHDITLDVSRRIYEAAR (序列号 1)
碱基 序列	ATGAACAACCTTTAATCTGCACACCCCAACCCGCATTCTGTTTGGT AAAGGCGCAATCGCTGGTTTACGCGAACAAATTCCTCACGATGCT CGCGTATTGATTACCTACGGCGGCGGCAGCGTGAAAAAACCGG CGTTCTCGATCAAGTTCTGGATGCCCTGAAAGGCATGGACGTGCT GGAATTTGGCGGTATTGAGCCAAACCCGGCTTATGAAACGCTGAT GAACGCCGTGAACTGGTTCGCGAACAGAAAGTGACTTTCCTGC TGGCGGTTGGCGGCGGTTCTGTACTGGACGGCACCAAATTTATC GCCGCAGCGGCTAACTATCCGGAATAATCGATCCGTGGCACATT CTGCAAACGGGCGGTAAGAGATTAAAAGCGCCATCCCGATGGG CTGTGTGCTGACGCTGCCAGCAACCGGTTTCTGAAATCCAACGCAG GCGCGGTGATCTCCCGTAAACACAGGCGACAAGCAGGCGTTC CATTCTGCCCATGTTCAGCCGGTATTTGCCGTGCTCGATCCGGTT TATACCTACACCCTGCCGCCGCGTCAGGTGGCTAACGGCGTAGTG GACGCCCTTTGTACACACCGTGGAACAGTATGTTACCAAACCGGTT GATGCCAAAATTCAGGACCGTTTTCGCAGAAGGCATTTTGCTGACG CTAATCGAAGATGGTCCGAAAGCCCTGAAAGAGCCAGAAAATA CGATGTGCGCGCAACGTCATGTGGGCGGCGACTCAGGCGCTGA ACGGTTTGATTGGCGCTGGCGTACCGCAGGACTGGGCAACGCAT ATGCTGGGCCACGAACTGACTGCGATGCACGGTCTGGATCACGC GCAAACACTGGCTATCGTCCTGCCTGCACTGTGGAATGAAAAAC GCGATACCAAGCGCGCTAAGCTGCTGCAATATGCTGAACGCGTCT GGAACATCACTGAAGGTTCCGATGATGAGCGTATTGACGCCGCG ATTGCCGCAACCCGCAATTTCTTTGAGCAATTAGGCGTGCCGACC CACCTCTCCGACTACGGTCTGGACGGCAGCTCCATCCCGGCTTT GCTGAAAAAACTGGAAGAGCACGGCATGACCCAACCTGGGCGAAA ATCATGACATTACGTTGGATGTCAGCCGCGGTATATACGAAGCCG CCCGCTAA (序列号 2)

[0150] 【表1-2】

[0151]

fucO / ACT44461.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MMANRMILNETAWFGRGAVGALTDEVKRRGYQKALIVTDKTLVQ CGVVAKVTDKMDAAGLAWAIYDGVVPNPPTITVVKEGLGVFQNSG ADYLIAIGGGSPQDTCKAIGHISNNPEFADVRSLEGLSPTNKPSVPI LAIPTTAGTAAEVTINYVITDEEKRRKFVCVDPHDIPQVAFIDADM MDGMPPALKAAATGVDALTHAIEGYITRGAWALTDALHIKAIEHAG ALRGSVAGDKDAGEEIALGQYVAGMGFSNVGLGLVHGMMAHPLGA FYNTPHGVANAILLPHVMRYNADFTGEKYRDIARVMGVKVEGMS LEEARNAAVEAVFALNRDVGIPPHLRDVGVRKEDIPALAQAALND VCTGGNPREATLEDIVELYHTAW (序列号 3)
碱基 序列	ATGATGGCTAACAGAATGATTCTGAACGAAACGGCATGGTTTGGT CGGGGTGCTGTTGGGGCTTTAACCGATGAGGTGAAACGCCGTGG TTATCAGAAGGCGCTGATCGTCACCGATAAAACGCTGGTGCAATG CGGCGTGGTGGCGAAAGTGACCGATAAGATGGATGCTGCAGGGC TGGCATGGGCGATTTACGACGGCGTAGTGCCCAACCCAACAATTA CTGTCGTCAAAGAAGGGCTCGGTGTATTCCAGAATAGCGGCGCG GATTACCTGATCGCTATTGGTGGTGGTTCTCCACAGGATACTTGT AAAGCGATTGGCATTATCAGCAACAACCCGGAGTTTGCCGATGTG CGTAGCCTGGAAGGGCTTTCCCCGACCAATAAACCCAGTGTACC GATTCTGGCAATCCCCACCACAGCAGGCACTGCGGCAGAAGTGA CCATTAACCTACGTGATCACTGACGAAGAAAAACGGCGCAAGTTTG TTTGCGTTGATCCGCATGATATCCCGCAGGTGGCGTTTATTGACG CTGACATGATGGATGGTATGCCTCCAGCGCTGAAAGCTGCGACG GGTGTGCGATGCGCTCACTCATGCTATTGAGGGGTATATTACCCGT GGCGCGTGGGCGCTAACCGATGCACTGCACATTAAAGCGATTGA AATCATTGCTGGGGCGCTGCGAGGATCGGTTGCTGGTGATAAGG ATGCCGGAGAAGAAATAGCGCTCGGGCAGTATGTTGCGGGTATG GGCTTCTCGAATGTTGGGTAGGGTTGGTGATGGTATGGCGCAT CCACTGGGCGCGTTTTATAACACTCCACACGGTGTTGCAAACGCC ATCCTGCTACCGCATGTCATGCGCTATAACGCTGACTTTACCGGT GAGAAGTACCGCGATATCGCGCGCGTTATGGGCGTGAAAGTGGA AGGTATGAGCCTGGAAGAGGCGCGTAATGCCGCTGTTGAAGCGG TGTTTGCTCTCAACCGTGATGTCGGTATTCCGCCACATTTGCGTG ATGTTGGGGTACGCAAGGAAGACATTCCGGCACTGGCGCAGGGC GCACTGAATGATGTTTGTACCGGTGGCAACCCGCGTGAAGCAAC GCTTGAGGATATTGTAGAGCTTTACCATAACCGCCTGGTAA (序列号 4)

[0152] 【表1-3】

[0153]

adhP / ACT43318.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MKAADVTKDHHVDVITYKTLRSLKHGEALLKMECCGVCHTDLHV KNGDFGDKTGVLGHEGIGVVAEVGPGVTSCLKPGDRASVAWFYEG CGHCEYCNSGNETLCRSVKNAAGYSVDGGMAEECIVVADYAVKVP DGLDSAAASSITCAGVTTYKAVKLSKIRPGQWIAIYGLGGLGNLAL QYAKNVFNAKVIAIDVNDEQLKLATEMGADLAINSHTEDAKIVQ EKTGGAHAADVTAFAKAFNSAVDAVRAGGRVVAVGLPPESMSLD IPRLVLDGIEVVGSLVGTRQDLTEAFQFAAEGKVVPKVALRPLADI NTIFTEMEEGKIRGRMVIDFRH (序列号 5)
碱基 序列	ATGAAGGCTGCAGTTGTTACGAAGGATCATCATGTTGACGTTACG TATAAAACACTGCGCTCACTGAAACATGGCGAAGCCCTGCTGAAA ATGGAGTGTTGTGGTGTATGTCATACCGATCTTCATGTTAAGAAT GGCGATTTTGGTGACAAAACCGGCGTAATTCTGGGCCATGAAGG CATCGGTGTGGTGGCAGAAGTGGGTCCAGGTGTCACCTCATTAA AACCAGGCGATCGTGCCAGCGTGGCGTGGTTCTACGAAGGATGC GGTCATTGCGAATACTGTAACAGTGGTAACGAAACGCTCTGCCGT TCAGTTAAAAATGCCGATACAGCGTTGATGGCGGGATGGCGGA AGAGTGCATCGTGGTCGCCGATTACGCGGTAAAAGTGCCAGATG GTCTGGACTCGGCGGCGGCCAGCAGCATTACCTGTGCGGGAGTC ACCACCTACAAAGCCGTAAAGCTGTCAAAAATTCGTCCAGGGCAG TGGATTGCTATCTACGGTCTTGGCGGTCTGGGTAACTCGCCCTG CAATACGCGAAGAATGTCTTTAACGCCAAAGTGATCGCCATTGAT GTCAATGATGAGCAGTTAAAACTGGCAACCGAAATGGGCGCAGA TTTAGCGATTAACTCACACACCGAAGACGCCGCCAAAATTTGTGCA GGAGAAAACCTGGTGGCGCTCACGCTGCGGTGGTAACAGCGGTAG CTAAAGCTGCGTTTAACTCGGCAGTTGATGCTGTCCGTGCAGGC GGTCGTGTTGTGGCTGTCCGTCTACCGCCGGAGTCTATGAGCCT GGATATCCCACGTCTTGTGCTGGATGGTATTGAAGTGGTCGGTTC GCTGGTCCGACGCGCCAGGATTTAACTGAAGCCTTCCAGTTTG CCGCCGAAGGTAAAGTGGTCCGAAAGTCGCCCTGCGTCCGTTA GCGGACATCAACACCATCTTTACTGAGATGGAAGAAGGCAAAATC CGTGGCCGCATGGTGATTGATTTCCGTCACTAA (序列号 6)

[0154] 【表1-4】

[0155]

ybbO / ACT42343.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MTHKATEILTGKVMQKSVLITGCSSGIGLESALELKRQGFHVLAG CRKPDDVERMNNMGFTGV LIDLDSPEVDRAADEVIALTDNCLYG IFNNAGFGMYGPLSTISRAQMEQQFSANFFGAHQLTMRLLPAMPLP HGEGRIVMTSSVMGLISTPGRGAYAASKYALEAWS DALRMELRHS GIKVS LIEPGPIRTRFTDNVNQTQSDKPVENPGIAARFTLGPEAVV DKVRHAFISEKPKMRYPVTLVTWAVMVLKRLLPGRVMDKILQG (序列号 7)
碱基 序列	ATGACTCATAAAGCAACGGAGATCCTGACAGGTAAAGTTATGCAA AAATCGGTCTTAATTACCGGATGTTCCAGTGGAATTGGCCTGGAA AGCGCGCTCGAATTAAAACGCCAGGGTTTTTCATGTGCTGGCAGG TTGCCGAAAACCGGATGATGTTGAGCGTATGAACAACATGGGATT TACCGGCGTGTTGATCGATCTGGATTCACCAGAAAGTGTTGATCG CGCAGCAGACGAGGTGATCGCCCTGACCGATAATTGTCTGTATGG GATCTTTAACAATGCCGGATTCGGCATGTATGGCCCCCTTTCCAC CATCAGCCGTGCGCAGATGGAACAGCAGTTTTCCGCCAACTTTTT CGGCGCACACCAGCTCACCATGCGCCTGTTACCCGCGATGTTACC GCACGGTGAAGGGCGTATTGTGATGACATCATCGGTGATGGGATT AATCTCCACGCCGGGTCGTGGCGCTTACGCGGCCAGTAAATATGC GCTGGAGGCGTGGTCAGACGCGCTGCGCATGGAGCTACGCCACA GCGGAATTAAAGTCAGCCTGATCGAACCCGGTCCCATTTCGTACTC GCTTCACCGACAACGTCAACCAGACGCAAAGTGATAAACCAGTC GAAAATCCCGGCATCGCCGCCCGCTTTACGTTGGGACCGGAAGC GGTGGTGGACAAAGTACGCCATGCTTTTATTAGCGAGAAGCCGA AGATGCGCTATCCGGTAACGCTGGTGACCTGGGCAGTAATGGTG CTTAAGCGCCTGCTGCCGGGGCGCGTGATGGACAAAATATTGCA GGGGTGA (序列号 8)

[0156] 【表1-5】

[0157]

eutG / ACT44165.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MQNELQTALFQAFTLNLQRVKTFSVPPVTLCGPGAVSSCGQQAQ TRGLKHLFVMADSFLHQAGMTAGLTRSLAVKGIAMTLWPCPVGE PCITDVCAAVAQLRESGCDGVIAFGGGSVLDAAKAVALLVTNPST LAEMSETSVLQPRPLIAIPTTAGTGSETTNVTVIIDAVSGRKQVLA HASLMPDVAILDAALTEGVPSHVTAMTGIDALTHAIEAYSALNATP FTDSLAIAGAIAMIGKSLPKAVGYGHDLAARESMLLASCMAGMAFS SAGLGLCHAMAHQPGAALHIPHGLANAMLLPTVMEFNRMVCRE RFSQIGRALRTKKSDDRDAINAVSELIAEVGIGKRLGDVGATSAHY GAWAQAALEDICLRSNPRTASLEQIVGLYAAAQ (序列号 9)
碱基 序列	ATGCAAAATGAATTGCAGACCGCGCTCTTTCAGGCGTTCGATACC CTGAATCTGCAACGGGTAAAAACATTTAGCGTTCACCGGTGACG CTTTGCGGTCCGGGCGCGGTGAGCAGTTGCGGGCAGCAAGCGCA AACGCGTGCGGCTGAAACATCTGTTCTGTGATGGCAGACAGCTTTT GCATCAGGCGGGGATGACCGCCGGGCTGACGCGCAGCCTGGCTG TTAAAGGCATCGCCATGACGCTCTGGCCATGTCCGGTGGGCGAA CCGTGCAATTACCGACGTGTGTGCAGCCGTGGCGCAGTTGCGTGA GTCAGGCTGTGATGGGGTGATCGCATTTGGCGGCGGCTCGGTGC TGGATGCGGCGAAAGCCGTGGCGTTGCTGGTGACGAACCCCGAT AGCACGCTGGCAGAGATGTCAGAAACCAGCGTTCTGCAACCGCG CTTGCCGCTGATTGCCATTCCAACGACCGCCGGAACCGGCTCTG AAACCACCAATGTAACGGTGATTATCGACGCGGTGAGCGGGCGC AAGCAGGTGTTAGCCCATGCCTCGCTGATGCCGGATGTGGCGAT CCTCGACGCCGCATTGACCGAAGGTGTGCCGTGCGATGTCACGG CGATGACCGGCATTGATGCGTTAACCCATGCCATTGAAGCATACA GCGCCCTGAACGCTACACCGTTTACCGACAGCCTGGCGATTGGT GCCATTGCGATGATTGGCAAATCGCTGCCGAAAGCGGTGGGCTA CGGTCACGACCTTGCCGCGCGCGAGAGCATGTTACTGGCTTCAT GTATGGCGGGAATGGCGTTTTTCCAGTGCGGGTCTTGGGTTGTGC CACGCGATGGCGCATCAGCCGGGCGCGGCGCTGCATATTCCGCA CGGTCTCGCGAACGCCATGTTGCTGCCAACGGTGATGGAATTTAA CCGGATGGTTTGTGCGTAACGCTTTAGTCAGATTGGTCGGGCACT GCGAACTAAAAAATCCGACGATCGTGACGCTATTAACGCGGTAAG TGAGCTGATTGCGGAAGTTGGGATTGGTAAACGACTGGGCGATG TTGGTGCGACATCTGCGCATTACGGCGCATGGGCGCAGGCCGCG CTGGAAGATATTTGTCTGCGCAGTAACCCGCGTACCGCCAGCCTG GAGCAGATTGTGCGCCTGTACGCAGCGGCGCAATAA (序列号 10)

[0158] 【表1-6】

[0159]

ahr / ACT45923.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MSMIKSYAAKEAGGELEVYEDPGELRPQDVEVQVDYCGICHSDL SMIDNEWGFSQYPLVAGHEVIGRVVALGSAAQDKGLQVQVRVGIG WTARSCGHCDACISGNQINCEQGAVPTIMNRGGFAEKL RADWQW VIPLPENIDIESAGPLLCGGITVFKPLLMHHITATSRVGVIGIGGLG HIAIKLLHAMGCEVTAFFSSNPAKEQEV LAMGADKVVNSRDPQAL KALAGQFDLIINTVNVSLDWQPYFEALTYGGNFHTV GAVLTPLSV PAFTLIAGDRSVSGSATGTPYELRKL MRFAARSKVAPTTELFPM SK INDAIQHVRD GKARYRVVLKADY (序列号 1 1)
碱基 序列	ATGTCGATGATAAAAAGCTATGCCGCAAAGAAGCGGGCGGAGA ACTGGAAGTTTATGAGTACGATCCCGGTGAGCTGAGGCCACAAG ATGTTGAAGTGCAGGTGGATTACTGCGGGATCTGCCATTCGGATC TGTCGATGATCGATAACGAATGGGGATTTTCACAATATCCGCTGG TTGCCGGGCATGAGGTGATTGGGCGCGTG GTGGCACTCGGGAGC GCCGCGCAGGATAAAGGTTTG CAGGTGCGGT CAGCGTGTCGGGAT TGGCTGGACGGCGCGTAGCTGTGGTCACTGCGACGCCTGTATTA GCGGTAATCAGATCAACTGCGAGCAAGGTGCGGTGCCGACGATT ATGAATCGCGGTGGCTTTGCCGAGAAGTTGCGTGCGGACTGGCA ATGGGTGATTCCACTGCCAGAAAATATTGATATCGAGTCCGCCGG GCCGCTGTTGTGCGGCGGTATCACGGTCTTTAAACCACTGTTGAT GCACCATATCACTGCTACCAGCCGCGTTGGGGTAATTGGTATTGG CGGGCTGGGGCATATCGCTATAAACTTCTGCACGCAATGGGATG CGAGGTGACAGCCTTTAGTTCTAATCCGGCGAAAGAGCAGGAAG TGCTGGCGATGGGTGCCGATAAAGTGGTGAATAGCCGCGATCCG CAGGCACTGAAAGCACTGGCGGGGCAGTTTGATCTCATTATCAAC ACCGTCAACGTCAGCCTCGACTGGCAGCCCTATTTTGAGGCGCT GACCTATGGCGGTAATTTCCATACGGTCGGTGCGGTTCTCACGCC GCTGTCTGTTCCGGCCTTTACGTTAATTGCGGGCGATCGCAGCGT CTCTGGTTCTGCTACCGGCACGCCTTATGAGCTGCGTAAGCTGAT GCGTTTTGCCGCCCGCAGCAAGGTTGCGCCGACCACCGAACTGT TCCCGATGTCGAAAATTAACGACGCCATCCAGCATGTGCGCGACG GTAAGGCGCGTTACCGCGTGGTGTGAAAGCCGATTATTGA (序列号 1 2)

[0160] 【表1-7】

[0161]

yahK / ACT42179.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MKIKAVGAYSAKQPLEPMDITRREPGPNDVKIEIAYCGVCHSDLH QVRSEWAGTVYPCVPGHEIVGRVAVGDQVEKYAPGDLVGVGCIV DSKHCEECEEDGLENYCDHMTGTYNSTPDEPGHTLGGYSQQIV VHERYVLRIRHPQEQLAAVAPLLCAGITTSPLRHWQAGPGKKVG VVGIGGLGHMGIKLAHAMGAHVVAFTTSEAKREAAKALGADEVV NSRNADEMAAHLKSFDLNTVAAPHNLDDFTTLLKRDGMTLV GAPATPHKSPEVFNLMKRRAIAGSMIGGIPETQEMLDFCAEHGIV ADIEMIRADQINEAYERMLRGDVKYRFVIDNRTLTD (序列号 1 3)
碱基 序列	ATGAAGATCAAAGCTGTTGGTGCATATTCCGCTAAACAACCACTT GAACCGATGGATATCACCCGGCGTGAACCGGGACCGAATGATGT CAAAATCGAAATCGCTTACTGTGGCGTTTGCCATTCCGATCTCCA CCAGGTCCGTTCCGAGTGGGCGGGGACGGTTTACCCCTGCGTGC CGGGTCATGAAATTGTGGGGCGTGTGGTAGCCGTTGGTGATCAG GTAGAAAAATATGCGCCGGGCGATCTGGTCGGTGTTCGGCTGCAT TGTCGACAGTTGTAAACATTGCGAAGAGTGTGAAGACGGGTTGG AAACTACTGTGATCACATGACCGGCACCTATAACTCGCCGACGC CGGACGAACCGGGCCATACTCTGGGCGGCTACTCACAAACAGATC GTCGTTTCATGAGCGATATGTTCTGCGTATTCGTCACCCGCAAGAG CAGCTGGCGGCGGTGGCTCCTTTGTTGTGTGCAGGGATCACCCAC GTATTCGCCGCTACGTCACTGGCAGGCCGGGCCGGGTAATAAAG TGGGCGTGGTCGGCATCGGCGGTCTGGGACATATGGGGATTAAG CTGGCCCACGCGATGGGGGCACATGTGGTGGCATTACCACTTC TGAGGCAAAACGCGAAGCGGCAAAAGCCCTGGGGGCCGATGAAG TTGTTAACTCACGCAATGCCGATGAGATGGCGGCTCATCTGAAGA GTTTCGATTTTCATTTTGAATACAGTAGCTGCGCCACATAATCTCG ACGATTTTACCACCTTGCTGAAGCGTGATGGCACCATGACGCTGG TTGGTGCGCCTGCGACACCGCATAAATCGCCGGAAGTTTTCAACC TGATCATGAAACGCCGTGCGATAGCCGTTCTATGATTGGCGGCA TTCCAGAACTCAGGAGATGCTCGATTTTGTGCGCCGAACATGGCA TCGTGGCTGATATAGAGATGATTCGGGCCGATCAAATTAATGAAG CCTATGAGCGAATGCTGCGCGGTGATGTGAAATATCGTTTTGTTA TCGATAATCGCACACTAACAGACTGA (序列号 1 4)

[0162] 【表1-8】

[0163]

adhE / ACT43105.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MAVTNVAELNALVERVKKAQREYASFTQEQVDKIFRAAALAAADA RIPLAKMAVAESGMGIVEDKVIKNHFASEYIYNAYKDEKTCGVLSE DDTFGTITIAEPIGIIICGIVPTTNPTSTAIFKSLISLKTRNAIIFSPHP RAKDATNKAADIVLQAAIAAGAPKDLIGWIDQPSVELSNALMHHP DINLILATGGPGMVKAAYSSGKPAIGVGAGNTPVVIDETADIKRAV ASVLMSKTFDNGVICASEQSVVVVDSVYDAVRERFATHGGYLLQG KELKAVQDVILKNGALNAAIVGQPAYKIAELAGFSVPENTKILIGE VTVVDSEPFHAHEKLSPTLAMYRAKDFEDAVEKA EKL VAMGGIGH TSCLYTDQDNQPARVSYFGQKMKTARILINTPASQGGIGDLYNFKL APSLTLGCGSWGGSISENVGPKHLINKKTVAKRAENMLWHKLP KSIYFRRGSLPIALDEVITDGHKRALIVTDRFLFNNGYADQITSVL KAAGVETEVEFFEVEADPTLSIVRKGAELANSFKPDVIIALGGGSPM DAAKIMWVMYEHPEETHFEELALRFMDIRKRIYKFKPMGMVKAKMI AVTTTSGTGSEVTPFAVVTDDATGQKYPLADYALTPDMAIVDANLV MDMPKSLCAFGGLDAVTHAMEAYVSVLASEFSDGQALQALKLLK EYLPASYHEGSKNPVARERVHSAATIAGIAFANAFLGVCHSMAHK LGSQFHIPHGLANALLICNVIRYNANDNPTKQTAFS QYDRPQARR RYAEIADHLGLSAPGDRTA AKIEKLLAWLET LKAELGIPKSIREAG VQEADFLANVDKLSEDAFDDQCTGANPRYPLISELKQILLDTYYG RDYVEGETAAKKEAAPAKAEKKAKKSA (序列号 15)
碱基 序列	ATGGCTGTTACTAATGTCGCTGAACTTAACGCACTCGTAGAGCGT GTAAAAAAGCCCAGCGTGAATATGCCAGTTTCACTCAAGAGCAA GTAGACAAAATCTTCCGCGCCGCGCTCTGGCTGCTGCAGATGC TCGAATCCCACTCGCGAAAATGGCCGTTGCCGAATCCGGCATGG GTATCGTCGAAGATAAAGTGATCAAAAACCACTTTGCTTCTGAAT ATATCTACAACGCTATAAAGATGAAAAAACCTGTGGTGTTCTGT CTGAAGACGACACTTTTGGTACCATCACTATCGCTGAACCAATCG GTATTATTTGCGGTATCGTTCCGACCACTAACCCGACTTCAACTG CTATCTTCAAATCGCTGATCAGTCTGAAGACCCGTAACGCCATTA TCTTCTCCCCGCACCCGCGTGCAAAAGATGCCACCAACAAAGCG GCTGATATCGTTCTGCAGGCTGCTATCGCTGCCGGTGCTCCGAAA GATCTGATCGGCTGGATCGATCAACCTTCTGTTGAACTGTCTAAC GCACTGATGCACCACCCAGACATCAACCTGATCCTCGCGACTGGT GGTCCGGGCATGGTTAAAGCCGCATACAGCTCCGGTAAACCAGC TATCGGTGTAGGCGCGGGCAACACTCCAGTTGTTATCGATGAAAC TGCTGATATCAAACGTGCAGTTGCATCTGTACTGATGTCCAAAAC CTTCGACAACGGCGTAATCTGTGCTTCTGAACAGTCTGTTGTTGT TGTTGACTCTGTTTATGACGCTGTACGTGAACGTTTTGCAACCCA

[0164]

	CGGCGGCTATCTGTTGCAGGGTAAAGAGCTGAAAGCTGTTTCAGG ATGTTATCCTGAAAAACGGTGCGCTGAACGCGGCTATCGTTGGTC AGCCAGCCTATAAAATTGCTGAACTGGCAGGCTTCTCTGTACCAG AAAACACCAAGATTCTGATCGGTGAAGTGACCGTTGTTGATGAAA GCGAACCGTTTCGCACATGAAAACTGTCCCCGACTCTGGCAATG TACCGCGCTAAAGATTTTGAAGACGCGGTAGAAAAAGCAGAGAA ACTGGTTGCTATGGGCGGTATCGGTCATACCTCTTGCCGTGTACAC TGACCAGGATAACCAACCGGCTCGCGTTTCTTACTTCGGTCAGAA AATGAAAACGGCGCGTATCCTGATTAACACCCCAGCGTCTCAGGG TGGTATCGGTGACCTGTATAACTTCAAACCTCGCACCTTCCCTGAC TCTGGGTTGTGGTTCTTGGGGTGGTAACTCCATCTCTGAAAACGT TGGTCCGAAACACCTGATCAACAAGAAAACCGTTGCTAAGCGAG CTGAAAACATGTTGTGGCACAACTTCCGAAATCTATCTACTTCC GCCGTGGCTCCCTGCCAATCGCGCTGGATGAAGTGATTACTGATG GCCACAAACGTGCGCTCATCGTGACTGACCGCTTCCTGTTCAACA ATGGTTATGCTGATCAGATCACTTCCGTACTGAAAGCAGCAGGCG TTGAAACTGAAGTCTTCTTCGAAGTAGAAGCGGACCCGACCCTG AGCATCGTTCGTAAAGGTGCAGAAGTGGCAAACCTCCTTCAAACCA GACGTGATTATCGCGCTGGGTGGTGGTTCCCCGATGGACGCCGC GAAGATCATGTGGGTTATGTACGAACATCCGGAAACTCACTTCGA AGAGCTGGCGCTGCGCTTTATGGATATCCGTAAACGTATCTACAA GTTCCCGAAAATGGGCGTGAAAGCGAAAATGATCGCTGTCACCA CCACTTCTGGTACAGGTTCTGAAGTCACTCCGTTTGCGGTTGTAA CTGACGACGCTACTGGTCAGAAATATCCGCTGGCAGACTATGCGC TGAATCCGGATATGGCGATTGTGACGCCAACCTGGTTATGGACA TGCCGAAGTCCCTGTGTGCTTTCGGTGGTCTGGACGCAGTAACT CACGCCATGGAAGCTTATGTTTCTGTACTGGCATCTGAGTTCTCT GATGGTTCAGGCTCTGCAGGCACTGAAACTGCTGAAAGAATATCT GCCAGCGTCCTACCACGAAGGGTCTAAAAATCCGGTAGCGCGTG AACGTGTTACAGTGCAGCGACTATCGCGGGTATCGCGTTTTCG AACGCCTTCCTGGGTGTATGTCACTCAATGGCGCACAACTGGGT TCCCAGTTCCATATTCCGCACGGTCTGGCAAACGCCCTGCTGATT TGTAACGTTATTCGCTACAATGCGAACGACAACCCGACCAAGCAG ACTGCATTTCAGCCAGTATGACCGTCCGCAGGCTCGCCGTCGTTAT GCTGAAATTGCCGACCACTTGGGTCTGAGCGCACCGGGCGACCG TACTGCTGCTAAGATCGAGAACTGCTGGCATGGCTGGAAACGC TGAAAGCTGAACTGGGTATTCCGAAATCTATCCGTGAAGCTGGCG TTCAGGAAGCAGACTTCCTGGCGAACGTGGATAAACTGTCTGAA GATGCATTTCGATGACCAGTGCACCGGCGCTAACCCGCGTTACCC GCTGATCTCCGAGCTGAAACAGATCCTGCTGGATACCTACTACGG
	TCGTGATTATGTAGAAGGTGAAACTGCAGCGAAAAAAGAAGCCG CTCCGGCTAAAGCTGAGAAAAAAGCGAAAAAATCCGCTTAA (序列号 16)

[0165] 【表1-9】

[0166]

ybdR / ACT42455.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MKALTYHGPHHVQVENVPDPGIEQADDIILRITATAICGSDLHLRYR GKIPQVKHGDIFGHEFMGEVVETGKDVKNLQKGDRVVIPFVIACG DCFFCRLQQYAACENTNAGKGAALNKKQIPAPAALFGYSHLYGGV PGGQAEYVRVPKGNVGPFPKVPPLLSDDKALFLSDILPTAWQAAKN AQIQQGSSVAVYGAGPVGLLTIACARLLGAEQIFVVDHHPYRLHFA ADRYGAIPINFDEDSIPAQSIIEQTAGHRGVDAVIDAVGFEEKGST TETVLTNLKLEGSSGKALRQCIAAVRRGGIVSVPGVYAGFIHGFLF GDAFDKGLSFKMGQTHVHAWLGELLPLIEKGLLKPEEIVTHYMP FEEAARGYEIFEKREEECRKVILVPGAQSAEAAQKAVSGLVNAMP GGTI (序列号 17)
碱基 序列	ATGAAAGCATTGACTTATCACGGCCACATCACGTTTCAGGTAGAA AATGTTCCCGATCCGGGCATTGAACAGGCAGATGATATTATTCTG CGTATTACGGCAACGGCGATCTGTGGCTCTGACCTCCATCTTTAT CGAGGCAAAATACCCAGGTTAAACATGGCGATATTTTTGGTCAT GAATTTATGGGGGAAGTCGTTGAAACCGGAAAGGACGTAAAAAA TTTGCAAAAAGGCGACCGGGTGGTAATTCGTTTGTCTATTGCTTG TGGCGACTGTTTTTTCTGTTCGATTACAGCAATATGCCGCCTGCGA AAATACCAATGCGGGTAAAGGCGCTGCGCTCAATAAAAAACAGAT ACCAGCTCCCGCGGCATTGTTTGGTTATAGTCACCTGTATGGCGG CGTTCCTGGTGGGCAGGCGGAATATGTCCGCGTCCCTAAAGGGA ATGTGGGGCCGTTTAAAGTACCGCCTTTGCTTTCAGATGATAAAG CGCTTTTCCTTTCTGATATTCTGCCAACGGCATGGCAGGCAGCAA AAAATGCGCAGATCCAACAAGGTTCAAGCGTTGCAGTCTATGGTG CTGGTCCTGTGGGATTGTTGACAATCGCCTGTGCACGGTTGCTC GGTGCGGAACAGATTTTTGTTGTTGATCATCATCCCTACCGCTTG CATTTCCGCCGCCGACCGCTACGGCGCGATCCCGATTAATTTTGAT GAAGACAGCGATCCGGCACAGTCAATTATTGAACAAACGGCAGG TCACCGGGGCGTGGATGCAGTAATAGACGCCGTCGGTTTTGAAG CGAAAGGCAGCACACGGAACGGTGCTGACTAACCTGAAACTG GAGGGCAGCAGCGGTAAAGCGTTGCGTCAGTGTATTGCGGCGGT CAGGCGTGGCGGCATTGTTAGCGTACCGGGCGTCTACGCTGGAT TTATTCACGGTTTCCTGTTTGGCGACGCCTTTGATAAAGGGTTGT CGTTTAAAATGGGACAGACCCACGTTACGCATGGCTGGGAGAA TTATTACCGTTAATTGAGAAAGGATTACTGAAACCAGAAGAAATT GTTACCACTATATGCCGTTTGAAGAGGCCGCCCGGGGATATGAG ATTTTCGAAAAACGTGAAGAGGAGTGCCGTAAGGTGATTCTGGTA CCCGGTGCACAAAGCGCAGAGGCGGCGCAGAAGGCGGTTTCAG GTCTAGTGAATGCGATGCCGGGGGGAACAATATGA (序列号 18)

[0167] 【表1-10】

[0168]

dkgA / ACT44689.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MANPTVIKLQDGNVMPQLGLGVWQASNEEVITAIQKALEVGYRSI DTAAAYKNEEGVGKALKNASVNREELFITTKLWNDDHKRPREAL LDSLKKLQLDYIDLILMHWPVPAIDHYVEAWKGMIELQKEGLIKS IGVCNFQIHHLQRLIDETGVTPVINQIELHPLMQQRQLHAWNATH KIQTESWSPLAQGGKGVFDQKVIRDLADKYGKTPAQIVIRWHLDS GLVVIPKSVTPSRIAENFDVWDFRLDKDELGEIAKLDQGKRLGPD PDQFGG (序列号 19)
碱基 序列	ATGGCTAATCCAACCGTTATTAAGCTACAGGATGGCAATGTCATG CCCCAGCTGGGACTGGGCGTCTGGCAAGCAAGTAATGAGGAAGT AATCACCGCCATTCAAAAAGCGTTAGAAGTGGGTTATCGCTCGAT TGATACCGCCGCGGCCTACAAGAACGAAGAAGGTGTCGGCAAAG CCCTGAAAAATGCCTCAGTCAACAGAGAAGAACTGTTTCATCACCA CTAAGCTGTGGAACGACGACCACAAGCGCCCCCGGAAGCCCTG CTCGACAGCCTGAAAAAACTCCAGCTTGATTATATCGACCTCTAC TTAATGCACTGGCCCGTTCCCGCTATCGACCATTATGTCGAAGCA TGGAAGGCATGATCGAATTGCAAAAAGAGGGATTAATCAAAAGC ATCGGCGTGTGCAACTTCCAGATCCATCACCTGCAACGCCTGATT GATGAAACTGGCGTGACGCCTGTGATAAACCAGATCGAACTTCAT CCGCTGATGCAACAACGCCAGCTACACGCCTGGAACGCGACACA CAAAATCCAGACCGAATCCTGGAGCCCATTAGCGCAAGGAGGGA AAGGCGTTTTTCGATCAGAAAGTCATTTCGCGATCTGGCAGATAAAT ACGGCAAAACCCCGGCGCAGATTGTTATCCGCTGGCATCTGGATA GCGGCCTGGTGGTGATCCCGAAATCGGTCACACCTTCACGTATTG CCGAAAACTTTGATGTCTGGGATTTCCGTCTCGACAAAGACGAAC TCGGCGAAATTGCAAACTCGATCAGGGCAAGCGTCTCGGTCCC GATCCTGACCAGTTCGGCGGCTAA (序列号 20)

[0169] 【表1-11】

[0170]

yiaY / ACT45243.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MASSTFFIPSVNVIGADSLTDAMNMMADYGFTRTLIVTDNMLTKL GMAGDVQKALEERNIFSUIYDGTQPNPTTENVAAGLKLLKENNC DSVISLGGGSPHDCAKGIALVAANGGDIRDYEGVDRSAKPQLPMI AINTTAGTASEMTRFCIITDEARHIKMAIVDKHVTPLLSVNDSSLM IGMPKSLTAATGMDALTHAIEAYVSIAATPITDACALKAVTMIAEN LPLAVEDGSNAKAREAMAYAQFLAGMAFNNASLGYVHAMAHQLG GFYNLPHGVCNAVLLPHVQVFNSKVAAARLRDCAAAMGVNVTGK NDAEGAEACINAIRELAKKVDIPAGLRDLNVKEEDFAVLATNALK DACGFTNPIQATHEEIVAIYRAAM (序列号 2 1)
碱基 序列	ATGGCATCTTCAACTTTCTTTATTCTTCTGTGAATGTCATCGGC GCTGATTCATTGACTGATGCAATGAATATGATGGCAGATTATGGA TTTACCCGTACCTTAATTGTCACTGACAATATGTTAACGAAATTAG GTATGGCGGGTGATGTGCAAAAAGCACTGGAAGAACGCAATATTT TTAGCGTTATTTATGATGGCACCCAACCTAACCCAACACGGAAA ACGTCGCCGCAGGTTTGAAATTACTTAAAGAAAATAATTGCGATA GCGTGATTTCTTAGGCGGTGGTTCTCCGCATGACTGTGCAAAAAG GTATTGCGCTGGTGGCAGCCAATGGTGGTGATATCCGTGATTATG AAGGCGTTGACCGCTCTGCAAAAACCGCAGCTGCCGATGATCGCC ATCAATACCACTGCGGGTACAGCATCAGAAATGACTCGTTTCTGC ATCATCACCGACGAAGCGCGTCACATCAAAATGGCGATTGTTGAT AAGCACGTGACTCCGCTGCTTTCTGTCAATGACTCCTCGCTGATG ATCGGTATGCCGAAGTCACTGACCGCCGCCACTGGTATGGACGC CTTAACGCACGCTATCGAAGCGTATGTTTCTATTGCCGCCACGCC GATCACTGACGCTTGTGCACTGAAAGCCGTGACCATGATTGCCG AAAACCTGCCGTTAGCCGTTGAAGATGGCAGTAATGCGAAAGCG CGTGAAGCAATGGCTTATGCCAGTTCCTCGCCGGTATGGCGTTC AATAATGCTTCTCTGGGTATGTTTCATGCGATGGCGCACCAGCTG GGCGGTTTCTACAACCTGCCACACGGTGTATGTAACGCCGTTTGT CTGCCGCATGTTTCAGGTATTCAACAGCAAAGTCGCCGCCGCACG TCTGCGTGACTGTGCCGCTGCAATGGGCGTGAACGTGACAGGTA AAAACGATGCGGAAGGTGCTGAAGCCTGCATTAACGCCATCCGT GAACTGGCGAAGAAAGTGGATATCCCGGCAGGCCTACGCGACCT GAACGTGAAAGAAGAAGATTTTCGCGGTTCTGGCGACTAATGCCC TGAAAGATGCCTGTGGTTTTACTAACCCGATCCAGGCAACTCACG AAGAAATTGTGGCGATTTATCGCGCAGCGATGTAA (序列号 2 2)

[0171] 【表1-12】

[0172]

frmA / ACT42209.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MKSRAAVAFAPGKPLEIVEIDVAPPKKGEVLIKVTHTGVCHTDAFT LSGDDPEGVFPVVLGHEGAGVVVEVGEGVTSVKPGDHIPLYTAE CGECEFCRSGKTNLCVAVRETQGKGLMPDGTTRFSYNGQPLYHY MGCSTFSEYTVVAEVSLAKINPEANHEHVCLLGCGVTTGIGAVHN TAKVQPGDSVAVFGLGAIGLAVVQGARQAKAGRIIAIDTNPKKFDL ARRFGATDCINPNDYDKPIKDVLDDINKWGDHTFECIGNVNVMR AALESAHRGWGQSVIIGVAGAGQEISTRPFQLVTGRVWKGSFAFGG VKGRSQLPGMVEDAMKGDIDLEPFVTHMTSLDEINDAFDLMHEG KSIRTVIRY (序列号 2 3)
碱基 序列	ATGAAATCACGTGCTGCCGTTGCATTTGCTCCCGGTAAACCGCTG GAAATCGTTGAAATTGACGTTGCACCACCGAAAAAGGTGAAGT GCTGATTAAAGTCACCCATACCGGCGTTTGCCATACCGACGCATT TACCCTCTCCGGGGATGACCCGGAAGGTGTATCCCGGTGGTTCT CGGTCACGAAGGGGCCGGCGTTGTGGTTGAAGTCGGTGAAGGCG TAACCAGCGTCAAACCTGGCGACCATGTGATCCCGCTTTACACCG CGGAGTGCGGCGAGTGTGAGTTCTGTCGTTCTGGCAAACTAAC CTCTGTGTTGCGGTTTCGCGAAACCCAGGGTAAAGGCTTGATGCC AGACGGCACCACCCGTTTTTCTTACAACGGGCAGCCGCTTTATCA CTACATGGGATGCTCAACATTCAGTGAATACACCGTGGTCGCGGA AGTGTCTCTGGCCAAAATTAATCCAGAAGCAAACCATGAACACGT CTGCCTGCTGGGCTGTGGCGTGACCACCGGTATTGGCGCGGTGC ACAACACAGCTAAAGTCCAGCCAGGTGATTCTGTTGCCGTGTTTG GTCTTGGCGCGATTGGTCTGGCAGTGGTTCAGGGCGCGCGTCAG GCGAAAGCGGGACGGATTATCGCTATCGATACCAACCCGAAGAA ATTCGATCTGGCTCGTCGCTTCGGTGCTACCGACTGCATTAACCC GAATGACTACGACAAACCGATTAAAGATGTCCTGCTGGATATCAA CAAATGGGGTATCGACCATACCTTTGAATGCATCGGTAACGTCAA CGTGATGCGTGCGGCGCTGGAAAGTGCGCACCGCGGCTGGGGTC AGTCGGTGATCATCGGGGTAGCAGGTGCCGGTCAGGAAATCTCC ACCCGACCATTCCAGTTGGTCACCGGTGCGGTATGGAAGGTTTC CGCGTTTGGCGGCGTGAAAGGTCGTTCCAGTTACCGGGTATGG TTGAAGATGCGATGAAAGGTGATATCGATCTGGAACCGTTTGTCA CGCATACCATGAGCCTTGATGAAATTAATGACGCCTTCGACCTGA TGCATGAAGGCAAATCCATTCGAACCGTAATTCGTTACTGA (序列 号 2 4)

[0173] 【表1-13】

[0174]

dkgB / ACT42101.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MAIPAFGLGTFRLKDDVVISSVKTALELGYRAIDTAQIYDNEAAVG QAIAESGVPRHELYITTKIWENLSKDKLIPSLKESLQKLRTDYVD LTLIHWSPNDEVSVVEEFMQELLEAKKEGLTREIGISNFTIPLMEK AIAAVGAENIATNQIELSPYLQNRKVVAWAKQHGIHITSYMTLAYG KALKDEVIARIAAKHNATPAQVILAWAMGEGYSVIPSSTKRKNLES NLKAQNLQLDAEDKKAIAALDCNDRLVSPEGLAPEWD (序列号 2 5)
碱基 序列	ATGGCTATCCCTGCATTGTTGGTTTAGGTACTTTCGGTCTGAAAGAC GACGTTGTTATTTTCATCTGTGAAAACGGCGCTTGAACCTGGTTAT CGCGCAATTGATACTGCACAAATCTATGATAACGAAGCCGCAGTA GGTCAGGCGATTGCAGAAAGTGGCGTGCCACGTCATGAACTCTA CATCACCCTAAAATCTGGATTGAAAATCTCAGCAAAGACAAATT GATCCCGAGTCTGAAAGAGAGCCTGCAAAAATTGCGTACTGATTA TGTTGATCTGACTCTAATCCACTGGCCGTCACCAAACGATGAAGT CTCTGTTGAAGAGTTTATGCAGGAGCTGCTGGAAGCCAAAAAAG AAGGGTTGACGCGTGAGATCGGTATTTCCAAC TTCAGATCCCAT TGATGGAAAAGGCGATTGCTGCTGTTGGCGCTGAAAACATCGCT ACTAACCAGATTGAACTCTCTCCTTATCTGCAAAACCGTAAAGTG GTTGCCTGGGCTAAACAGCACGGCATCCATATTACTTCCTATATG ACGCTGGCGTATGGTAAGGCCCTGAAAGATGAGGTTATTGCTCGT ATCGCAGCTAAACACAATGCGACTCCGGCACAAGTGATTCTGGC GTGGGCTATGGGGGAAGGTTACTCAGTAATTCCTTCTTCTACTAA ACGTAAAAACCTGGAAAGTAATCTTAAGGCACAAAATTTACAGCT TGATGCCGAAGATAAAAAAGCGATCGCCGCACTGGATTGCAACG ACCGCCTGGTTAGCCCGGAAGGTCTGGCTCCTGAATGGGATTAA (序列号 2 6)

[0175] 【表1-14】

[0176]

yghA / ACT44682.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MSHLKDPTTQYYTGEYPKQKQPTPGIQAKMTPVPDCGEKTYVGS GRLKDRKALVTGGDSGIGRAAAIAYAREGADVAISYLPVEEEDAQD VKKIIIEECGRKAVLLPGDLSDEKFARSLVHEAHKALGGLDIMALVA GKQVAIPDIADLTSEQFQKTFAINVFALFWLTQEAIPLLPKGASIIT TSSIQAYQPSPHLLDYAATKAAILNYSRGLAKQVAEKGIRVNIVAPG PIWTALQISGGQTQDKIPQFGQQTPMKRAGQPAELAPVYVYLASQ ESSYVTAEVHGVCGGEHLG (序列号 27)
碱基 序列	ATGTCTCATT TAAAAGACCCGACCACGCAGTATTACACTGGTGAA TATCCCAAACAGAAACAACCGACGCCAGGCATCCAGGCGAAGAT GACACCGGTACCGGATTGCGGCGAGAAAACCTATGTTGGTAGCG GTCGCCTGAAAGATCGTAAAGCACTGGTGACAGGGGGCGATTCC GGAATAGGTGCGCGCTGCCGCCATCGCTTACGCGCGTGAAGGGGC TGACGTGGCGATCAGTTATCTTCCCGTGGAAGAAGAAGACGCTC AGGATGTGAAAAAGATCATTGAAGAATGCGGACGCAAAGCCGTT CTGCTGCCAGGCGATTTAAGCGATGAGAAATTTGCCCGTTTCGCTG GTTACGAAGCGCACAAAGGCGTTAGGCGGGCTGGATATTATGGC GCTGGTCCGCGGGAACAGGTTGCCATTCCGGATATTGCAGACC TCACCAGCGAACAGTTTCAAAGACCTTTGCCATTAACGTTTTTCG CGCTGTTCTGGCTAACCCAGGAAGCGATCCCCCTGCTACCGAAA GGTGCAAGTATCATCACCCTTCGTCAATCCAGGCATACCAGCCA AGTCCGCATTTACTGGACTATGCGGCTACGAAGGCGGCGATTCTG AACTACAGCCGTGGCTTGGCAAAACAGGTCGCGGAGAAAGGTAT TCGGGTGAATATTGTCGCGCCAGGCCCGATCTGGACAGCACTGC AAATTTCCGGCGGACAAACGCAGGATAAGATCCCGCAGTTTGGT CAGCAAACGCCGATGAAACGTGCGGGGCAACCGGCGGAACTGGC CCCTGTATATGTTTATCTGGCAAGTCAGGAGTCGAGCTACGTCAC CGCAGAAGTGACGGCGTGTGCGGCGGCGAGCATTTAGGTAA (序列号 28)

[0177] 【表1-15】

[0178]

ydjG / ACT43594.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MKKIPLGTTDITLSRMGLGTWAIGGGPAWNGDLDRQICIDTILEAH RCGINLIDTAPGYNFGNSEVIVGQALKKLPREQVVVETKCGIVWE RKGS LFNKVGD RQLYKNLSPESIREEVEASLQRLGIDYIDIYMT WQSVPPFFTPIAETVAVLNELKAEGKIRAIGANVDADHIREYLQY GELDIHQAKYSILDRAMENELLPLCRDNGIVVQVYSPLEQGLLTGT ITRDYVPGGARANKVWFQRENMLKVIDMLEQWQPLCARYQCTIP TLALAWILKQSDLISILSGATAPEQVRENVAALNINLSADATLMR EMAEALER (序列号 29)
碱基 序列	ATGAAAAAATACCTTTAGGCACAACGGATATTACGCTTTCGCGA ATGGGGTTGGGGACATGGGCCATTGGCGGCGGTCCTGCATGGAA TGGCGATCTCGATCGGCAAATATGTATTGATACGATTCTTGAAGC CCATCGTTGCGGCATTAATCTGATTGATACTGCACCAGGATATAA CTTTGGCAATAGTGAAGTTATCGTCGGTCAGGCGTTAAAAAACT GCCCCGTGAACAGGTTGTAGTAGAAACCAAATGCGGCATTGTCT GGGAACGAAAAGGAAGTTTATTCAACAAAGTTGGCGATCGGCAG TTGTATAAAAACCTTTCCCCGGAATCTATCCGCGAAGAGGTAGAA GCCAGCTTGCAACGTCTGGGTATTGATTACATCGATATCTACATG ACGCACTGGCAGTCGGTGCCGCCATTTTTTACGCCGATAGCTGAA ACTGTGCGCAGTGCTTAATGAGTTAAAAGCCGAAGGGGAAAATTCGC GCGATAGGCGCTGCTAACGTCGATGCTGACCATATCCGCGAGTAT CTGCAATATGGTGAACCTGGATATTATTCAGGCGAAATACAGTATC CTCGACCGGGCAATGGAAAACGAACTGCTGCCGCTATGTCGTGA TAATGGCATTGTGGTTCAGGTTTATTCCCCGCTAGAGCAGGGATT GTTGACCGGCACCATCACTCGTGATTACGTTCCGGGCGGCGCTC GGGCAAATAAAGTCTGGTTCAGCGTGAAAACATGCTGAAAGTG ATTGATATGCTTGAACAGTGGCAGCCACTTTGTGCTCGTTATCAG TGCAACAATTCCCACTCTGGCACTGGCGTGGATATTAAAACAGAGT GATTTAATCTCCATTCTTAGTGGGGCTACTGCACCGGAACAGGTA CGCGAAAATGTCGCGGCACTGAATATCAACTTATCGGATGCAGAC GCAACATTGATGAGGGGAAATGGCAGAGGCCCTGGAGCGTTAA (序列号 30)

[0179] 【表1-16】

[0180]

gldA / ACT45624.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MDRIIQSPGKYIQGADVINRLGEYLNKPLAERWLVVGDKFVLGFAQ STVEKSFKDAGLVVEIAPFGGECSEQNEIDRLRGIAETAQCGAILGI GGGKTLDTAKALAHFMGVPVAIAPTIASTDAPCSALSVIYTDEGEF DRYLLLPNNPNMVIVDTKIVAGAPARLLAAGIGDALATWFEARAC SRSGATTMAGGKCTQAALALAEKCYNTLLEEGEKAMLAEEQHVV TPALERVIEANTYLSGVGFESGGLAAAHAVHNGLTAIPTDAHHYYH GEKVAFGTLTQLVLENAPVEEIEETVAALSHAVGLPITLAQLDIKED VPAKMRIVAEAAACAEGETIHNMPGGATPDQVYAALLVADQYGQRF LQWE (序列号 3 1)
碱基 序列	ATGGACCGCATTATTCAATCACCGGGTAAATACATCCAGGGCGCT GATGTGATTAATCGTCTGGGCGAATACCTGAAGCCGCTGGCAGAA CGCTGGTTAGTGGTGGGTGACAAATTTGTTTTAGGTTTTGCTCAA TCCACTGTCGAGAAAAGCTTTAAAGATGCTGGACTGGTAGTAGAA ATTGCGCCGTTTGGCGGTGAATGTTTCGCAAAATGAGATCGACCGT CTGCGTGGCATCGCGGAGACTGCGCAGTGTGGCGCAATTCTCGG TATCGGTGGCGGAAAAACCCTCGATACTGCCAAAGCACTGGCAC ATTTTCATGGGTGTTCCGGTAGCGATCGCACCGACTATCGCCTCTA CCGATGCACCGTGCAGCGCATTGTCTGTTATCTACACCGATGAGG GTGAGTTTGACCGCTATCTGCTGTTGCCAAATAACCCGAATATGG TCATTGTCGACACCAAAATCGTCGCTGGCGCACCTGCACGTCTGT TAGCGGCGGGTATCGGCGATGCGCTGGCAACCTGGTTTGAAGCG CGTGCTGCTCTCGTAGCGGCGCGACCACCATGGCGGGCGGCAA GTGCACCCAGGCTGCGCTGGCACTGGCTGAACTGTGCTACAACA CCCTGCTGGAAGAAGGCGAAAAAGCGATGCTTGCTGCCGAACAG CATGTAGTGACTCCGGCGCTGGAGCGCGTGATTGAAGCGAACAC CTATTTGAGCGGTGTTGGTTTTGAAAGTGGTGGTCTGGCTGCGG CGCACGCAGTGCATAACGGCCTGACCGCTATCCCGGACGCGCAT CACTATTATCACGGTGAAAAAGTGGCATTTCGGTACGCTGACGCAG CTGGTTCTGGAACCGCGCCGGTGGAGGAAATCGAAACCGTAGC TGCGCTTAGCCATGCGGTAGGTTTGCCAATAACTCTCGCTCAACT GGATATTAAAGAAGATGTCCCGGCGAAAAATGCGAATTGTGGCAGA AGCGGCATGTGCAGAAGGTGAAACCATCCACAACATGCCTGGCG GCGCGACGCCAGATCAGGTTTACGCCGCTCTGCTGGTAGCCGAC CAGTACGGTCAGCGTTTCCTGCAAGAGTGGGAATAA (序列号 3 2)

[0181] 【表1-17】

[0182]

yohF / ACT43891.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MAQVAIITASDSGIGKECALLLAQQGFDIGITWHSDEEGAKDTARE VVSHGVRAEIVQLDLGNLPEGALALEKLIQRLGRIDVLVNNAGAM TKAPFLDMAFDEWRKIFTVDVDGAF LCSQIAARQMVKQGGGRII NITSVHEHTPLPDASAYTAAKHALGGLTKAMALELVRHKILVNAV APGAIATPMNGMDDSDVKPDAEPSIPLRRFGATHEIASLVVWLCS EGANYTTGQSLIVDGGFMLANPQFNPE (序列号 3 3)
碱基 序列	ATGGCACAGGTTGCGATTATTACCGCCTCCGATTCGGGGATCGGC AAAGAGTGC GCGTTATTACTGGCGCAGCAGGGGTTTGATATTGGT ATTACCTGGCACTCAGATGAAGAAGGGGCAAAAGATACCGCGCG TGAGGTAGTTAGCCACGGCGTACGTGCGGAGATCGTG CAGCTGG ATCTCGGCAATCTACCAGAAGGGGCACTGGCGCTGGAGAAACTC ATTCAACGGCTGGGGCGCATTGATGTGCTGGTGAATAATGCGGG TGCAATGACCAAAGCGCCGTTTCTTGATATGGCTTTTGATGAGTG GCGCAAGATTTTTACCGTTGATGTGCGATGGTG CATTCTTATGCTC GCAAATTGCGGCTCGTCAGATGGTGAAACAAGGGCAGGGCGGTC GCATCATCAACATTACGTCCGTACATGAACATACGCCGCTGCCGG ATGCCAGCGCCTACACAGCCGCTAAACATGCGCTCGGTGGGTTA ACCAAAGCGATGGCGCTGGAGCTGGTCAGGCATAAGATTTTGGT GAACGCAGTCGCGCCTGGGGCGATCGCCACGCCAATGAATGGCA TGGATGACAGCGACGTGAAGCCCGACGCGGAGCCTTCGATTCCC TTGCGGCGTTTTGGCGCAACGCATGAGATTGCCAGCCTGGTGGT GTGGCTTTGTTTCGGAGGGCGCAAATTACACCACCGGGCAGTCGT TGATAGTGGATGGCGGCTTTATGTTGGCGAATCCACAGTTCAACC CAGAATAG (序列号 3 4)

[0183] 【表1-18】

[0184]

yeaE / ACT43604.1 / Escherichia coli BL21(DE3)	
氨基酸 序列	MQQKMIQFSGDVSLPAVGQGTWYMGEDASQRKTEVAALRAGIEL GLTLIDTAEMYADGGAKEVVG EALTGLREKVFLVSKVYPWNAGG QKAINACEASLRRLNTDYLDLYLLHWSGSFAFEETVAAMEKLIQ GKIRRWGVS NLDYADMQELWQLPGGNQCATNQVLYHLGSRGIEY DLLPWCQQQQMPVMAYSPLAQAGRLRNGLLKNNAVVNEIAHAHNI SAAQVLLAWVISHQGVMAIPKAATIAHVQQNAAVLEVELSSAELA MLDKAYPAPKGTALDMV (序列号 3 5)
碱基 序列	ATGCAACAAAAAATGATTCAATTTAGTGGCGATGTCTCACTGCCA GCCGTAGGGCAGGGAACATGGTATATGGGCGAAGATGCCAGTCA GCGCAAAACAGAAGTTGCTGCACTACGCGCGGGCATTGAACTCG GTTTAACCCTCATTGATACCGCCGAAATGTATGCCGATGGCGGTG CCGAAAAGGTGGTTGGGGAAGCATTAAACCGGTCTGCGAGAGAAG GTCTTTCTCGTCTCTAAAGTCTATCCGTGGAATGCTGGCGGGCAA AAAGCGATAAATGCATGCGAAGCCAGTTTACGCCGTCTCAATACT GATTATCTCGATCTTTACTTATTACACTGGTCTGGCAGTTTTCGCTT TTGAAGAGACTGTGCGCAGCGATGGAAAAATTGATCGCCCAGGGA AAAATCCGCCGCTGGGGCGTTTCTAACCTTGATTATGCTGATATG CAGGAACTCTGGCAGCTGCCGGGGGGAAATCAGTGTGCCACTAA TCAGGTGCTTTACCATCTCGGTTACGAGGAATTGAGTACGATCT ACTCCCCTGGTGCCAGCAACAGCAGATGCCGGTGATGGCTTACA GTCCGTTAGCCCAGGCCGGGCGGTTGCGCAATGGACTGTAAAAA AACGCGGTAGTCAACGAAATTGCACATGCTCACAATATCAGCGCG GCACAAGTATTGTTGGCGTGGGTGATCAGTCATCAGGGTGTGAT GGCGATTCCAAAAGCGGCCACGATTGCCCATGTCCAACAAAATG CGGCTGTGCTTGAGGTGGAACCTTCTTCAGCGGAATTAGCTATGC TGGATAAGGCATATCCGGCACCAAAAGGAAAACTGCGCTGGATA TGGTGTGA (序列号 3 6)

[0185] 【表1-19】

[0186]

ADH1 / NP_014555.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MSIPETQKGVIFYESHGKLEYKDIPVPKPKANELLINVKYSGVCH TDLHAWHGDWPLPVKLPLVGGHEGAGVVVGMGENVKGWKIGDY AGIKWLNGSCMACEYCELGNESNCPHADLSGYTHDGSFQQYATA DAVQAAHIPQGTDLAQVAPILCAGITVYKALKSANLMAGHWVAIS GAAGGLGSLAVQYAKAMGYRVLGIDGGEGKEELFRSIGGEVFIDF TKEKDIVGAVLKATDGGAHGVINVSVSEAAIEASTRYVRANGTTVL VGMPAGAKCCSDVFNQVVKISIVGSYVGNRADTREALDFFARGL VKSPIKVVLSTLPEIYEKMEKGQIVGRYVVDTSK (序列号 3 7)
碱基 序列	ATGTCTATCCCAGAACTCAAAAAGGTGTTATCTTCTACGAATCC CACGGTAAGTTGGAATACAAAGATATTCAGTTCCAAAGCCAAAG GCCAACGAATTGTTGATCAACGTAAATACTCTGGTGTCTGTAC ACTGACTTGACGCTTGGCACGGTGACTGGCCATTGCCAGTTAA GCTACCATTAGTCGGTGGTCACGAAGGTGCCGGTGTCGTTGTCTG GCATGGGTGAAAACGTTAAGGGCTGGAAGATCGGTGACTACGCC GGTATCAAATGGTTGAACGGTTCTTGTATGGCCTGTGAATACTGT GAATTGGGTAACGAATCCAACGTCTCACGCTGACTTGTCTGGT TACACCCACGACGGTTCTTTCCAACAATACGCTACCGCTGACGCT GTTCAAGCCGCTCACATTCCTCAAGGTACCGACTTGCCCCAAGTC GCCCCCATCTTGTGTGCTGGTATCACCGTCTACAAGGCTTTGAAG TCTGCTAACTTGATGGCCGGTCACTGGGTTGCTATCTCCGGTGCT GCTGGTGGTCTAGGTTCTTTGGCTGTTCAATACGCCAAGGCTATG GGTTACAGAGTCTTGGGTATTGACGGTGGTGAAGGTAAGGAAGA ATTATTCAGATCCATCGGTGGTGAAGTCTTCATTGACTTCACTAA GGAAAAGGACATTGTCGGTGCTGTTCTAAAGGCCACTGACGGTG GTGCTCACGGTGTCATCAACGTTTCCGTTTCCGAAGCCGCTATTG AAGCTTCTACCAGATACGTTAGAGCTAACGGTACCACCGTTTTGG TCGGTATGCCAGCTGGTGCCAAGTGTTGTTCTGATGTCTTCAACC AAGTCGTCAAGTCCATCTCTATTGTTGGTTCTTACGTCGGTAACA GAGCTGACACCAGAGAAGCTTTGGACTTCTTCGCCAGAGGTTTG GTCAAGTCTCCAATCAAGGTTGTCGGCTTGCTACCTTGCCAGAA ATTTACGAAAAGATGGAAGGGTCAAATCGTTGGTAGATACGTT GTTGACACTTCTAAATAA (序列号 3 8)

[0187] 【表1-20】

[0188]

ADH2 / NP_014032.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MSIPETQKAIIFYESNGKLEHKDIPVPKPKPNELLINVKYSGVCHT DLHAWHGDWPLPTKLPLVGGHEGAGVVVGMGENVKGWKIGDYA GIKWLNNGSCMACEYCELGNESNCPHADLSGYTHDGSFQEYATAD AVQAAHIPQGTDLAEVAPILCAGITVYKALKSANLRAGHWAAISGA AGGLGSLAVQYAKAMGYRVLGIDGGPGKEELFTSLGGEVFIDFTK EKDIVSAVVKATNGGAHGIINVSVSEAAIEASTRYCRANGTVVLVG LPAGAKCSSDVFNHVVKISIVGSGYVGNRADTREALDFFARGLVKS PIKVVG LSSLPEIYEKMEKGQIAGRYVVDTSK (序列号 39)
碱基 序列	ATGTCTATTCCAGAACTCAAAAAGCCATTATCTTCTACGAATCC AACGGCAAGTTGGAGCATAAGGATATCCCAGTTCCAAAGCCAAA GCCCAACGAATTGTTAATCAACGTCAAGTACTCTGGTGTCTGCCA CACCGATTTGCACGCTTGGCATGGTGACTGGCCATTGCCAACTAA GTTACCATTAGTTGGTGGTCACGAAGGTGCCGGTGTCGTTGTCTG GCATGGGTGAAAACGTTAAGGGCTGGAAGATCGGTGACTACGCC GGTATCAAATGGTTGAACGGTTCCTTGTATGGCCTGTGAATACTGT GAATTGGGTAACGAATCCAACGTCTCCTCACGCTGACTTGTCTGGT TACACCCACGACGGTTCCTTCCAAGAATACGCTACCGCTGACGCT GTTCAAGCCGCTCACATTCCTCAAGGTACTGACTTGGCTGAAGTC GCGCCAATCTTGTGTGCTGGTATCACCGTATACAAGGCTTTGAAG TCTGCCAACTTGAGAGCAGGCCACTGGGCGGCCATTTCTGGTGC TGCTGGTGGTCTAGGTTCTTTGGCTGTTCAATATGCTAAGGCGAT GGGTTACAGAGTCTTAGGTATTGATGGTGGTCCAGGAAAGGAAG AATTGTTTACCTCGCTCGGTGGTGAAGTATTCATCGACTTCACCA AAGAGAAGGACATTGTTAGCGCAGTCGTTAAGGCTACCAACGGC GGTGCCACGGTATCATCAATGTTTCCGTTTCCGAAGCCGCTATC GAAGCTTCTACCAGATACTGTAGGGCGAACGGTACTGTTGTCTTG GTTGGTTTGCCAGCCGGTGCAAAGTGCTCCTCTGATGTCTTCAAC CACGTTGTCAAGTCTATCTCCATTGTCGGCTCTTACGTGGGGAAC AGAGCTGATACCAGAGAAGCCTTAGATTTCTTTGCCAGAGGTCTA GTCAAGTCTCCAATAAAGGTAGTTGGCTTATCCAGTTTACCAGAA ATTTACGAAAAGATGGAGAAGGGCCAAATTGCTGGTAGATACGTT GTTGACACTTCTAAATAA (序列号 40)

[0189] 【表1-21】

[0190]

ADH3 / NP_013800.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MLRTSTLFTRRVQPSLF SRNLRRLQSTAAIPKTQKGVIFYENKGKL HYKDIPVPEPKPNEILINVKYSGVCHTDLHAWHGDWPLPVKLPLV GGHEGAGVVVKLGSNVKGWKVGDLAGIKWLN GSCMTCEFCESG HESNCPDADLSGYTHDGSFQQFATADAIQAAKIQQGTDLAEVAPIL CAGVTVYKALKEADLKAGDWVAISGAAGGLGSLAVQYATAMGYRV LGIDAGEEKEKLFKKLGGEVFIDFTKTKNMVSDIQEATKGGPHGV INVSVSEAAISLSTEYVRPCGTVVVLVGLPANAYVKSEVFSHVVKSI NIKGSYVGNRADTREALDFFSRGLIKSPIKIVGLSEL PKVYDLMEK GKILGRYVVDTSK (序列号 4 1)
碱基 序列	ATGTTGAGAACGTCAACATTGTTCAACAGGCGTGTCCAACCAAGC CTATTTTCTAGAAACATTCTTAGATTGCAATCCACAGCTGCAATCC CTAAGACTCAAAAAGGTGTCATCTTTTATGAGAATAAGGGGAAGC TGCATTACAAAGATATCCCTGTCCCCGAGCCTAAGCCAAATGAAA TTTAAATCAACGTAAATATTCTGGTGTATGTCACACCGATTTACA TGCTTGGCACGGCGATTGGCCATTACCTGTTAAACTACCATTAGT AGGTGGTCATGAAGGTGCTGGTGTAGTTGTCAA ACTAGGTTCCA ATGTCAAGGGCTGGAAAGTCGGTGATTTAGCAGGTATCAAATGGC TGAACGGTTCTTGTATGACATGCGAATTCTGTGAATCAGGTCATG AATCAAATTGTCCAGATGCTGATTTATCTGGTTACACTCATGATG GTTCTTTCCAACAATTTGCGACCGCTGATGCTATTCAAGCCGCCA AAATTCAACAGGGTACCGACTTGGCCGAAGTAGCCCCAATATTAT GTGCTGGTGT TACTGTATATAAAGCACTAAAAGAGGCAGACTTGA AAGCTGGTGA CTGGGTTGCCATCTCTGGTGCTGCAGGTGGCTTG GGTTCCTTGGCCGTTCAATATGCAACTGCGATGGGTTACAGAGTT CTAGGTATTGATGCAGGTGAGGAAAAGGAAAAACTTTTCAAGAAA TTGGGGGGTGAAGTATTCATCGACTTTACTAAAACAAAGAATATG GTTTCTGACATTCAAGAAGCTACCAAAGGTGGCCCTCATGGTGTC ATTAACGTTTCCGTTTCTGAAGCCGCTATTTCTCTATCTACGGAAT ATGTTAGACCATGTGGTACCGTCGTTTTGGTTGGTTTGCCCGCTA ACGCCTACGT TAAATCAGAGGTATTCTCTCATGTGGTGAAGTCCA TCAATATCAAGGGTTCTTATGTTGGTAACAGAGCTGATACGAGAG AAGCCTTAGACTTCTTTAGCAGAGGTTTGATCAAATCACCAATCA AAATTGTTGGATTATCTGAATTACCAAAGGTTTATGACTTGATGG AAAAGGGCAAGATTTTGGGTAGATACGTCGTCGATACTAGTAAAT AA (序列号 4 2)

[0191] 【表1-22】

[0192]

ADH4 / NP_011258.2 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MSSVTGFIYIPPISSFFGEGALEETADYIKNKDYKKALIVTDPGIAAIG LSGRVQKMLEERDLNVAIYDKTQPNPNIANVTAGLKVLEQNSEI VVSIGGGS AHDNAKAIALLATNGGEIGDYEGVNQSKKAALPLFAI NTTAGTASEMTRFTIISNEEKKIKMAIIDNNVTPAVAVNDPSTMFG LPPALTAATGLDALTHCIEAYVSTASNPI TDACALKGIDLINESLVA AYKDGKDKKARTDMCYAEYLAGMAFNNASLG YVHALAHQLGGF YHLPHGVCNAVLLPHVQEANMQCPKAKKRLGEIALHFGASQEDP EETIKALHVLNRTMNIPRNLKELGVKTEDFEILAEHAMHDACHLT NPVQFTKEQVVAIIKKAYEY (序列号 4 3)
碱基 序列	ATGTCTTCCGTTACTGGGTTTTACATTCCACCAATCTCTTTCTTTG GTGAAGGTGCTTTAGAAAGAAACCGCTGATTACATCAAAAACAAGG ATTACAAAAAGGCTTTGATCGTTACTGATCCTGGTATTGCAGCTA TTGGTCTCTCCGGTAGAGTCCAAAAGATGTTGGAAGAACGTGAC TTAAACGTTGCTATCTATGACAAAAC TCAACCAAACCCAAATATT GCCAATGTACAGCTGGTTTTGAAGGTTTTGAAGGAACAAAAC TCT GAAATTGTTGTTTCCATTGGTGGTGGTTCTGCTCACGACAATGCT AAGGCCATTGCTTTATTGGCTACTAACGGTGGGGAAATCGGAGAC TATGAAGGTGTCAATCAATCTAAGAAGGCTGCTTTACCACTATTT GCCATCAACACTACTGCTGGTACTGCTTCCGAAATGACCAGATTC ACTATTATCTCTAATGAAGAAAAGAAAATCAAGATGGCTATCATT GACAACAACGTCACTCCAGCTGTTGCTGTCAACGATCCATCTACC ATGTTTGGTTTGCCACCTGCTTTGACTGCTGCTACTGGTCTAGAT GCTTTGACTCACTGTATCGAAGCTTATGTTTCCACCGCCTCTAAC CCAATCACCGATGCCTGTGCTTTGAAGGGTATTGATTTGATCAAT GAAAGCTTAGTCGCTGCATACAAAGACGGTAAAGACAAGAAGGC CAGAACTGACATGTGTTACGCTGAATACTTGGCAGGTATGGCTTT CAACAATGCTTCTCTAGGTTATGTTTCATGCCCTTGCTCATCAACT TGGTGGTTTCTACCACTTGCCCTCATGGTGTGTTGTAACGCTGTCTT GTTGCCCTCATGTTCAAGAGGCCAACATGCAATGTCCAAAGGCCAA GAAGAGATTAGGTGAAATTGCTTTGCATTTCCGGTGCTTCTCAAGA AGATCCAGAAGAAACCATCAAGGCTTTGCACGTTTTAAACAGAAC CATGAACATTCCAAGAACTTGAAAGAATTAGGTGTAAAACCGA AGATTTTGAAATTTTGGCTGAACACGCCATGCATGATGCCTGCCA TTTGACTAACCAGTTCAATTCACCAAAGAACAAGTGGTTGCCAT TATCAAGAAAGCCTATGAATATTAA (序列号 4 4)

[0193] 【表1-23】

[0194]

ADH5 / NP_009703.3 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MPSQVIPEKQKAIVFYETDGKLEYKDVTVPPEPKPNEILVHVKYSG VCHSDLHAWHGDWPFQLKFPLIGGHEGAGVVVKLGSNVKGWKV GDFAGIKWLNGTCMSCEYCEVGNESQCPYLDGTGFTHDGTFQEY ATADAVQAAHIPPNVNLAEVAPILCAGITVYKALKRANVIPGQWVT ISGACGGLGSLAIQYALAMGYRVIGIDGGNAKRKLFEQLGGEIFID FTEEKDIVGAIKATNGGSHGVINVSVSEAAIEASTRYCRPNGTVV LVGMPAHAYCNSDVFNQVVKSSISIVGSCVGNRADTREALDFFARG LIKSPIHLAGLSDVPEIFAKMEKGEIVGRYVVETSK (序列号 4 5)
碱基 序列	ATGCCTTCGCAAGTCATTCCTGAAAAACAAAAGGCTATTGTCTTT TATGAGACAGATGGAAAATTGGAATATAAAGACGTCACAGTTCCG GAACCTAAGCCTAACGAAATTTTAGTCCACGTTAAATATTCTGGT GTTTGTGCATAGTGACTTG CACGCGTGGCACGGTGATTGGCCATTT CAATTGAAATTTCCATTAATCGGTGGTCACGAAGGTGCTGGTGTT GTTGTTAAGTTGGGATCTAACGTTAAGGGCTGGAAAGTCGGTGAT TTTG CAGGTATAAAAATGGTTGAATGGGACTTG CATGTCCTGTGAA TATTGTGAAGTAGGTAATGAATCTCAATGTCCTATTTGGATGGTA CTGGCTTCACACATGATGGTACTTTTCAAGAATACGCAACTGCCG ATGCCGTTCAAGCTGCCCATATTCCACCAAACGTCAATCTTGCTG AAGTTGCCCCAATCTTGTGTGCAGGTATCACTGTTTATAAGGCGT TGAAAAGAGCCAATGTGATACCAGGCCAATGGGTCACTATATCCG GTGCATGCGGTGGCTTGGGTTCTCTGGCAATCCAATACGCCCTTG CTATGGGTACAGGGTCATTGGTATCGATGGTGGTAATGCCAAGC GAAAGTTATTTGAACAATTAGGCGGAGAAAATATTCATCGATTTCA CGGAAGAAAAAGACATTGTTGGTGCTATAATAAAGGCCACTAATG GCGGTTCTCATGGAGTTATTAATGTGTCTGTTTCTGAAGCAGCTA TCGAGGCTTCTACGAGGTATTGTAGGCCCAATGGTACTGTCGTCC TGGTTGGTATGCCAGCTCATGCTTACTGCAATTCCGATGTTTTCA ATCAAGTTGTAAAATCAATCTCCATCGTTGGATCTTGTGTTGGAA ATAGAGCTGATACAAGGGAGGCTTTAGATTTCTTCGCCAGAGGTT TGATCAAATCTCCGATCCACTTAGCTGGCCTATCGGATGTTCCCTG AAATTTTGTCAAAGATGGAGAAGGGTGAAATTGTTGGTAGATATG TTGTTGAGACTTCTAAATGA (序列号 4 6)

[0195] 【表1-24】

[0196]

ADH6 / NP_014051.3 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MSYPEKFEGLIAIQSHEDWKNPKKTKYDPKPFYDHDIDIKIEACGV CGSDIHCAAGHWGNMKNMPLVVGHEIVGKVVKLGPKSNSGLKVG QRVGVGAQVFSCLECDRCKNDNEPYCTKFVTTYSQPYEDGYVSQ GGYANYVRVHEHFVPIPIENIPSHLAAPLLCGGLTVYSPLVRNGC GPGKKVGIVGLGGIGSMGTLISKAMGAETYVISRSSRKREDAMKM GADHYIATLEEGDWGEKYFDTFDLIVVCASSLTDIDFNIMPKAMK VGGRIVSISIPEQHEMLSLKPYGLKAVSISYSALGSIKELNQLLKL SEKDIKIWVETLPVGEAGVHEAFERMEKGDVRYRFTLVGYDKEFS D (序列号 47)
碱基 序列	ATGTCTTATCCTGAGAAATTTGAAGGTATCGCTATTCAATCACAC GAAGATTGGAAAAACCCAAAGAAGACAAAGTATGACCCAAAACC ATTTTACGATCATGACATTGACATTAAGATCGAAGCATGTGGTGT CTGCGGTAGTGATATTCATTGTGCAGCTGGTCATTGGGGCAATAT GAAGATGCCGCTAGTCGTTGGTCATGAAATCGTTGGTAAAGTTGT CAAGCTAGGGCCCAAGTCAAACAGTGGGTTGAAAGTCGGTCAAC GTGTTGGTGTAGGTGCTCAAGTCTTTTCATGCTTGGAATGTGACC GTTGTAAGAATGATAATGAACCATACTGCACCAAGTTTGTACCA CATACAGTCAGCCTTATGAAGACGGCTATGTGTGCGCAGGGTGGCT ATGCAAACACTACGTCAGAGTTCATGAACATTTTGTGGTGCCTATCC CAGAGAATATTCCATCACATTTGGCTGCTCCACTATTATGTGGTG GTTTGACTGTGTACTCTCCATTGGTTCGTAACGGTTGCGGTCCAG GTAAAAAAGTTGGTATAGTTGGTCTTGGTGGTATCGGCAGTATGG GTACATTGATTTCCAAAGCCATGGGGGCAGAGACGTATGTTATTT CTCGTTCTTCGAGAAAAAGAGAAGATGCAATGAAGATGGGCGCC GATCACTACATTGCTACATTAGAAGAAGGTGATTGGGGTGAAAAG TACTTTGACACCTTCGACCTGATTGTAGTCTGTGCTTCCTCCCTT ACCGACATTGACTTCAACATTATGCCAAAGGCTATGAAGGTTGGT GGTAGAATTGTCTCAATCTCTATAACCAGAACACGAAATGTTA TCGCTAAAGCCATATGGCTTAAAGGCTGTCTCCATTTCTTACAGT GCTTTAGGTTCCATCAAAGAATTGAACCAACTCTTGAAATTAGTC TCTGAAAAAGATATCAAAATTTGGGTGGAAACATTACCTGTTGGT GAAGCCGGCGTCCATGAAGCCTTCGAAAGGATGGAAAAGGGTGA CGTTAGATATAGATTTACCTTAGTTCGGCTACGACAAAGAATTTTC AGACTAG (序列号 48)

[0197] 【表1-25】

[0198]

ADH7 / NP_010030.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MLYPEKFQGGIGISNAKDWKHPKLVSFDPKPFGDHDVDVEIEACGI CGSDFHIAVGNWGPVPENQILGHEIIGRVVKVGSKCHTGVKIGDR VGVGAQALACFECERCKSDNEQYCTNDHVLTMWTPYKDKGYISQG GFASHVRLHEHFQIPENIPSPLAAPLLCGGITVFSPLLRNGCGP GKRVGIVGIGGIGHMGILLAKAMGAEVYAFSRGHSKREDSMKLGA DHYIAMLEDKGWTEQYSNALDLLVVCSSSLSKVNFDSIVKIMKIG GSIVSIAAPEVNEKLVKPLGLMGVSISSSAIGSRKEIEQLLKLVS KNVKIWVEKLPISEEGVSHAFTRMESGDVKYRFTLVDYDKKFKH (序列号 49)
碱基 序列	ATGCTTTACCCAGAAAAATTTTCAGGGCATCGGTATTTCCAACGCA AAGGATTGGAAGCATCCTAAATTAGTGAGTTTTGACCCAAAACCC TTTGGCGATCATGACGTTGATGTTGAAATTGAAGCCTGTGGTATC TGCGGATCTGATTTTCATATAGCCGTTGGTAATTGGGGTCCAGTC CCAGAAAATCAAATCCTTGACATGAAATAATTGGCCGCGTGGTG AAGGTTGGATCCAAGTGCCACACTGGGGTAAAAATCGGTGACCG TGTGTTGGTGTGGTGCCCAAGCCTTGGCGTGTTTTGAGTGTGAAC GTTGCAAAAAGTGACAACGAGCAATACTGTACCAATGACCACGTTT TGACTATGTGGACTCCTTACAAGGACGGCTACATTTTACAAGGAG GCTTTGCCTCCACGTGAGGCTTCATGAACACTTTGCTATTCAAA TACCAGAAAATATTCCAAGTCCGCTAGCCGCTCCATTATTGTGTG GTGGTATTACAGTTTTCTCTCCACTACTAAGAAATGGCTGTGGTC CAGGTAAGAGGGTAGGTATTGTTGGCATCGGTGGTATTGGGCATA TGGGGATTCTGTTGGCTAAAGCTATGGGAGCCGAGGTTTATGCGT TTTCGCGAGGCCACTCCAAGCGGGAGGATTCTATGAAACTCGGT GCTGATCACTATATTGCTATGTTGGAGGATAAAGGCTGGACAGAA CAATACTCTAACGCTTTGGACCTTCTTGTCGTTTGCTCATCATCTT TGTCGAAAGTTAATTTTGACAGTATCGTTAAGATTATGAAGATTG GAGGCTCCATCGTTTCAATTGCTGCTCCTGAAGTTAATGAAAAGC TTGTTTTAAACCGTTGGGCCTAATGGGAGTATCAATCTCAAGCA GTGCTATCGGATCTAGGAAGGAAATCGAACAACCTATTGAAATTAG TTTCCGAAAAGAATGTCAAAATATGGGTGGAAAACTTCCGATCA GCGAAGAAGGCGTCAGCCATGCCTTTACAAGGATGGAAAGCGGA GACGTCAAATACAGATTTACTTTGGTCGATTATGATAAGAAATTC CATAAATAG (序列号 50)

[0199] 【表1-26】

[0200]

SFA1 / NP_010113.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MSAATVGKPIKCIAAVAYDAKKPLSVEEITVDAPKAHEVRIKIEYT AVCHTDAYTLSGSDPEGLFPCVLGHEGAGIVESVGDDVITVKPGD HVIALYTAECGKCKFCTSGKTNLCGAVRATQGKGVMPTDGTTRFH NAKGEDIYHFMGCSTFSEYTVVADVSVVAIDPKAPLDAACLLGCG VTTGFGAALKTANVQKGD TVAVFGCGTVGLSVIQGAKLRGASKIIA IDINNKKKQYCSQFGATDFVNPKE DLAKDQTIVEKLIEMTDGGLD FTFDCTGNTKIMRDALEACHKGWGQSIIGVAAAGEEISTRPFQLV TGRVWKGSAFGGIKGRSEMGLIKDYQKGALKVEEFITHRRPFKE INQAFEDLHNGDCLRTVLKSDEIK (序列号 5 1)
碱基 序列	ATGTCCGCCGCTACTGTTGGTAAACCTATTAAGTG CATTGCTGCT GTTGCGTATGATGCGAAGAAACCATTAAGTGTGAAGAAATCACG GTAGACGCCCCAAAAGCGCACGAAGTACGTATCAAAATTGAATAT ACTGCTGTATGCCACACTGATGCGTACACTTTATCAGGCTCTGAT CCAGAAGGACTTTTCCCTTGCGTTCTGGGCCACGAAGGAGCCGG TATCGTAGAATCTGTAGGCGATGATGTCATAACAGTTAAGCCTGG TGATCATGTTATTGCTTTGTACACTGCTGAGTGTGGCAAATGTAA GTTCTGTACTTCCGGTAAAACCACTTATGTGGTGCTGTTAGAGC TACTCAAGGGAAAGGTGTAATGCCTGATGGGACCACAAGATTTCA TAATGCGAAAGGTGAAGATATATACCATTTTCATGGGTTGCTCTAC TTTTTCCGAATATACTGTGGTGGCAGATGTCTCTGTGGTTGCCAT CGATCCAAAAGCTCCCTTGATGCTGCCTGTTTACTGGGTTGTGG TGTTACTACTGGTTTTGGGGCGGCTCTTAAGACAGCTAATGTGCA AAAAGGCGATACCGTTGCAGTATTTGGCTGCGGGACTGTAGGAC TCTCCGTTATCCAAGGTGCAAAGTTAAGGGGCGCTTCCAAGATCA TTGCCATTGACATTAACAATAAGAAAAACAATATTGTTCTCAATT TGGTGGCACGGATTTTGTTAATCCCAAGGAAGATTTGGCCAAAGA TCAAACATATCGTTGAAAAGTTAATTGAAATGACTGATGGGGGTCT GGATTTTACTTTTGACTGTACTGGTAATACCAAATTATGAGAGAT GCTTTGGAAGCCTGTCATAAAGGTTGGGGTCAATCTATTATCATT GGTGTGGCTGCCGCTGGTGAAGAAATTTCTACAAGGCCGTTCCA GCTGGTCACTGGTAGAGTGTGGAAAGGCTCTGCTTTTGGTGGCA TCAAAGGTAGATCTGAAATGGGCGGTTTAATTAAAGACTATCAAA AAGGTGCCTTAAAAGTCGAAGAATTTATCACTCACAGGAGACCAT TCAAAGAAATCAATCAAGCCTTTGAAGATTTGCATAACGGTGATT GCTTAAGAACCGTCTTGAAGTCTGATGAAATAAAATAG (序列号 5 2)

[0201] 【表1-27】

[0202]

AAD3 / NP_010032.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MIGSASDSSSKLGRLRFLSETAAIKVSPLILGEVSYDGARSDFLKS MNKNRAFELLDTFYEAGGNFIDAANNCQNEQSEEWIGEWIQSRR LRDQIVIATKFIKSDKKYKAGESNTANYCGNHKRSLSHVSVRDSLRL KLQTDWIDILYVHWWDYMSSIEEFMDSLHILVQQGKVLVLYGVSDT PAWVVSAANYATSYGKTPFSIYQGKWNVLNRDFERDIIPMARHF GMALAPWDVMGGGRFQSKKAMEERRKNGEGIRSFVGASEQTDA EIKISEALAKIAEEHGTESVTAIAIAYVRSAKNFFPSVEGGKIEDL KENIKALSIDLTPDNIKYLESIVPFDIGFPNNFIVLNSLTQKYGTNN V (序列号 5 3)
碱基 序列	ATGATTGGGTCCGCGTCCGACTCATCTAGCAAGTTAGGACGCCTC CGATTTCTTTCTGAAACTGCCGCTATTAAAGTATCCCCGTTAATCC TAGGAGAAGTCTCATACGATGGAGCACGTTCCGATTTTCTCAAAT CAATGAACAAGAATCGAGCTTTTGAATTGCTTGATACTTTTTACG AGGCAGGTGGAAATTTCAATTGATGCCGCAAACAACTGCCAAAAC GAGCAATCAGAAGAATGGATTGGTGAATGGATACAGTCCAGAAG GTTACGTGATCAAATTGTCATTGCAACCAAGTTTATAAAAAGCGA TAAAAAGTATAAAGCAGGTGAAAGTAACACTGCCAACTACTGTGG TAATCACAAGCGTAGTTTACATGTGAGTGTGAGGGATTCTCTCCG CAAATTGCAAACCTGATTGGATTGATATACTTTACGTTCACTGGTG GGATTATATGAGTTCAATCGAAGAATTTATGGATAGTTTGCATATT CTGGTCCAGCAGGGCAAGGTCCTCTATTTGGGTGTATCTGATACA CCTGCTTGGGTTGTTTCTGCGGCAAACACTACTACGCTACATCTTAT GGTAAAACTCCCTTTAGTATCTACCAAGGTAAATGGAACGTGTTG AACAGAGATTTTGAGCGTGATATTATTCCAATGGCTAGGCATTTC GGTATGGCCCTCGCCCCATGGGATGTCATGGGAGGTGGAAGATT TCAGAGTAAAAAAGCAATGGAGGAACGGAGGAAGAATGGAGAGG GTATTCGTTCTTTTCGTTGGCGCCTCCGAACAAACAGATGCAGAAA TCAAGATTAGTGAAGCATTGGCCAAGATTGCTGAGGAACATGGCA CTGAGTCTGTTACTGCTATTGCTATTGCCTATGTTTCGCTCTAAGG CGAAAAATTTTTTTCCGTCGGTTGAAGGAGGAAAAATTGAGGATC TCAAAGAGAACATTAAGGCTCTCAGTATCGATCTAACGCCAGACA ATATAAAATACTTAGAAAGTATAGTTCCTTTTGACATCGGATTTCC TAATAATTTTATCGTGTTAAATTCCTTGACTCAAAAATATGGTACG AATAATGTTTAG (序列号 5 4)

[0203] 【表1-28】

[0204]

AAD4 / NP_010038.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MGSMNKEQAFELLD AFYEAGGNCIDTANSYQNEESEIWIGEWK SRKLRDQIVIA TKFTG DYKKYEVGGGKSANYCGNHKHS LHVSVR DSLRLQTDWIDILYVHWWDYMSSIEEVMDSLHILVQQGKVLYLG VSDTPAWVVSAANY YATSHGKTPFSIYQGKWNVLNRDFERDIIPM ARHFGMALAPWDVMGGGRFQSKKAMEERKKNGEGLRTVSGTSK QTDKEVKISEALAKVAEEHGTESVTAIAIAYVRSAKNVFPPLVGGR KIEHLKQNI EALS I KLTPEQIEYLESHIPFDVGFPTNFIGDDPAVTK KASLLTAMSAQISFD (序列号 5 5)
碱基 序列	ATGGGCTCTATGAATAAGGAACAGGCTTTTGAACCTCTTGATGCT TTTTATGAAGCAGGAGGTAATTGCATTGATACTGCAAACAGTTAC CAAAATGAAGAGTCAGAGATTTGGATAGGTGAATGGATGAAATCA AGAAAGTTGCGTGACCAAATTGTAATTGCCACCAAGTTTACCGGA GATTATAAGAAGTATGAAGTAGGTGGCGGTAAAAGTGCCAAC TAT TGTGGTAATCACAAGCATAGTTTACATGTGAGTGTGAGGGATTCT CTCCGCAAATTGCAA ACTGATTGGATTGATATACTTTACGTT CAC TGGTGGGATTATATGAGTTCAATCGAAGAAGTTATGGATAGTTTG CATATTTTAGTTTCAGCAGGGCAAAGTCCTCTATTTGGGTGTGTCT GATACACCTGCTTGGGTTGTTTCTGCGGCAA ACTACTACGCCACA TCTCATGGGAAA ACTCCTTTTAGTATCTATCAAGGTAAATGGAAT GTGTTGAACAGGGACTTTGAGCGCGATATCATTC CAATGGCCAGA CATTTTGGTATGGCTCTAGCCCCATGGGATGTTATGGGAGGTGGA AGATTTTCAGAGTAAAAAAGCAATGGAGGAACGGAAGAAGAATGG AGAGGGTCTGCGTACTGTTTTCGGG TACTTCTAAACAGACGGATAA AGAGGTTAAGATCAGTGAAGCATTGGCCAAGGTTGCTGAGGAAC ATGGCACTGAGTCTGT TACTGCTATTGCTATTGCCTATGTT CGCT CTAAGGCGAAAAATGTTTTCCCATTTGGTTGGTGGAAGGAAAATTG AACACCTCAAACAGAACATTGAGGCTTTAAGTATCAA ACTGACAC CAGAACAGATAGAATACTTAGAAAAGTATTATTCCTTTTGATGTTG GTTTTCTACTAATTTTATCGGTGATGATCCGGCTGTTACCAAGA AGGCTTCACTTCTCACGGCAATGTCTGCGCAGATTTCTCTCGATT AA (序列号 5 6)

[0205] 【表1-29】

[0206]

AAD10 / NP_012689.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MASRKLRDQIVIA TKFTTDYKGYDVGKGK SANFCGNH KRS LHVS VRDSLRLKLQTDWIDILYVHWWDYMSSIEEVMDSLHILVQQGKVL LGVS DTPAWVVSAANYATSHGKTPFSIYQGKWNVLNRDFERDII PMARHFGMALAPWDV MGGGRFQSKKAVEERKKKG EGLRTFFGT SEQTDM EVKISEALLKVAEEHGTESVTAIAIAYVRSKAKHV FPLVG GRKIEHLKQNI EALS I KLTPEQIKYLESIVPFDVGFPTNFIGDDPAV TKKPSFLTEMSAKISFED (序列号 57)
碱基 序列	ATGGCATCAAGAAA ACTGCGTGACCAGATTGTAATTGCCACTAAA TTTACCACGGATTATAAGGGGTATGATGTAGGCAAGGGGAAGAGT GCCAATTTCTGTGGGAATCACAAGCGCAGTTTGCATGTAAGTGTG AGAGATTCCCTTCGTAAGTTGCAA ACTGATTGGATTGATATTCTT TACGTTCACTGGTGGGATTATATGAGCTCCATTGAGGAAGTTATG GATAGTTTGCACATTCTTGTGCAGCAGGGCAAAGTACTCTATCTA GGTGTGTCTGATACTCCTGCCTGGGTTGTTTCTGCAGCAAATTAC TACGCCACATCTCATGGTAAAACTCCCTTTAGTATCTATCAAGGTA AATGGAATGTATTGAACAGGGACTTTGAACGTGATATCATTCCAA TGGCTAGGCATTTTGGTATGGCTCTTGCTCCATGGGATGTTATGG GAGGCGGGAGATTTTCAGAGTAAAAAGGCAGTGGAAGAGCGGAAG AAGAAAGGAGAAGGCTTGCGTACCTTTTTTGGTACTTCGGAACA GACGGATATGGAGGTAAAAATCAGCGAAGCATTGTAAAAAGTTGC GGAAGAACATGGCACTGAGTCTGTCACTGCTATTGCCATAGCTTA TGTTCCGGTCTAAAGCGAAACATGTTTTCCCATTAGTGGGAGGAAG AAAGATCGAACATCTCAAACAGAACATTGAGGCTTTGAGCATTA ATTAACACCAGAACAAATAAAGTACTTAGAAAAGTATTGTTCCTTTT GATGTCGGATTTCCCACTAATTTTATTGGAGATGACCCAGCTGTT ACCAAGAAACCTTCATTTCTACCGAAATGTCTGCCAAGATTAGC TTCGAAGATTAG (序列号 58)

[0207] 【表1-30】

[0208]

AAD14 / NP_014068.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MTDLFKPLPEPPTTELGRRLRVLSKTAGIRVSPLILGGASIGDAWSGF MGSMNKEQAFELLDIFYEAGGNCIDTANSYQNEESEIWIGEWMA SRKLRDQIVIATKFTGDKYKYEYVGGGKSANYCGNHRSLHVSVRD SLRKLQTDWIDILYIHWWDYMSSIEEVMDSLHILVQQGKVLYLGV SDTPAWVVSAANYATSHGKTPFSVYQGKWNVLNRDFERDIIPMA RHFGMALAPWDVMGGGRFQSKKAMEERKKNGEGLRTFVGGPEQ TELEVKISEALTKIAEEHGTESVTAIAIAYVRSKAKNVFPLIGGRKI EHLKQNIEALSIKLTPEQIEYLESIVPFDVGFPKSLIGDDPAVTKKL SPLTSMASARIAFDN (序列号 59)
碱基 序列	ATGACTGACTTGTTTAAACCTCTACCTGAACCACCTACCGAATTG GGACGTCTCAGGGTTCTTTCTAAAACTGCCGGCATAAGGGTTTCA CCGCTAATTCTGGGAGGAGCTTCAATCGGCGACGCATGGTCAGG CTTTATGGGCTCTATGAATAAGGAACAGGCCTTTGAACTTCTTGA TGCTTTTATGAAGCTGGAGGTAATTGTATTGATACTGCAAACAG TTACCAAAATGAAGAGTCAGAGATTTGGATAGGTGAATGGATGGC ATCAAGAAAACCTGCGTGACCAGATTGTAATTGCCACCAAGTTTAC CGGAGATTATAAGAAGTATGAAGTAGGTGGTGGTAAAAGTGCCAA CTACTGTGGTAATCACAAGCGTAGTTTACATGTGAGTGTGAGGGA TTCTCTCCGCAAATTGCAAACCTGATTGGATTGATATACTTTACATT CACTGGTGGGATTATATGAGTTCAATCGAAGAAGTTATGGATAGT TTGCATATTTTAGTTCAGCAGGGCAAGGTCCTATATTTAGGAGTA TCTGATACACCTGCTTGGGTTGTTTCTGCGGCAAATTACTACGCT ACATCTCATGGTAAAACTCCTTTTAGCGTCTATCAAGGTAAATGG AATGTATTGAACAGGGACTTTGAGCGTGATATTATCCAATGGCT AGGCATTTTGGTATGGCTCTAGCCCCATGGGATGTCATGGGAGGT GGAAGATTTTCAAGAGTAAAAAAGCAATGGAAGAACGGAAGAAGAA TGGAGAGGGTCTGCGTACTTTTGTGGGTGGCCCCGAACAAACAG AATTGGAGGTTAAAATCAGCGAAGCATTGACTAAAATTGCTGAGG AACATGGAACAGAGTCTGTACTGCTATCGCTATTGCCTATGTTC GCTCTAAAGCGAAAAATGTTTTCCCATTTGATTGGAGGAAGGAAAA TTGAACATCTCAAGCAGAACATTGAGGCTTTGAGTATTAAATTAA CACCGGAACAAATAGAAATACCTGGAAAGTATTGTTCCTTTTGATG TTGGCTTTCCCAAAGTTTAATAGGAGATGACCCAGCGGTAACCA AGAAGCTTTCACCCCTCACATCGATGTCTGCCAGGATAGCTTTTG ACAATTAG (序列号 60)

[0209] 【表1-31】

[0210]

AAD15 / NP_014477.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MARHFGMALAPWDVMGGGRFQSKKAMEERRKNGECIRSFVGAS EQTDAEIKISEALAKVAEEHGTESVTAIAIAYVRSKAKNVFPSVEG GKIEDLKENIKALSIDLTDPDNIKYLENVVPFDIGFPNTFIVLNSLTQ KYGTNNV (序列号 6 1)
碱基 序列	ATGGCTAGGCATTTTCGGTATGGCCCTCGCCCCATGGGATGTCATG GGAGGTGGAAGATTTTCAGAGTAAAAAAGCAATGGAGGAACGGAG GAAGAATGGAGAGTGTATTCGTTCTTTCGTTGGCGCCTCCGAACA AACAGATGCAGAAATCAAGATTAGTGAAGCATTAGCCAAGGTTGC TGAGGAACATGGCACTGAGTCTGTTACTGCTATTGCTATTGCCTA TGTTTCGCTCTAAGGCGAAAAATGTTTTTCCGTCGGTTGAAGGAGG AAAAATTGAGGATCTCAAAGAGAACATTAAGGCTCTCAGTATCGA TCTAACGCCGGACAATATAAAATACTTGGAAAATGTAGTTCCTTT TGACATCGGATTTTCCTAACACTTTTATCGTGTTAAATTCCTTGACT CAAAAATATGGTACGAATAATGTTTAG (序列号 6 2)

[0211] 【表1-32】

[0212]

YPR1 / NP_010656.1 / <i>Saccharomyces cerevisiae</i> S288C	
氨基酸 序列	MPATLKNSSATLKLNTGASIPVLGFGTWRSVDNNGYHSVIAALKA GYRHIDAAAIYLNNEEEVGRAIKDSGVPREEIFITTKLWGTEQRDPE AALNKSLKRLGLDYVDLYLMHWPVPLKTDRTDGNVLCIPTLED GTVDIDTKEWNFIKTWELMQELPKTGKTKAVGVSNFSINNIKELL ESPNNKVVPATNQIEIHPLLPQDELIAFCKEKGIVVEAYSPFGSAN APLLKEQAIIDMAKKHGVPAQLIISWSIQRGYVVLAKSVNPERIV SNFKIFTLPEDDFKTISNLSKVHGTGRVVDMMKWGSFPIFQ (序列 号 6 3)
碱基 序列	ATGCCTGCTACGTAAAGAATTCTTCTGCTACATTAAAACTAAATA CTGGTGCTCCATTCCAGTGTTGGGTTTCGGCACTTGGCGTTCGG TTGACAATAACGGTTACCATTCTGTAATTGCAGCTTTGAAAGCTG GATACAGACACATTGATGCTGCGGCTATCTATTTGAATGAAGAAG AAGTTGGCAGGGCTATTAAAGATTCCGGAGTCCCTCGTGAGGAA ATTTTTATTACTACTAAGCTTTGGGGTACGGAACAACGTGATCCG GAAGCTGCTCTAAACAAGTCTTTGAAAAGACTAGGCTTGGATTAT GTTGACCTATATCTGATGCATTGGCCAGTGCCTTTGAAAACCGAC AGAGTTACTGATGGTAACGTTCTGTGCATTCCAACATTAGAAGAT GGCACTGTTGACATCGATACTAAGGAATGGAATTTTATCAAGACG TGGGAGTTGATGCAAGAGTTGCCAAAGACGGGCAAACTAAAGC CGTTGGTGTCTCTAATTTTTCTATTAACAACATTAAAGAATTATTA GAATCTCCAAATAACAAGGTGGTACCAGCTACTAATCAAATTGAA ATTCATCCATTGCTACCACAAGACGAATTGATTGCCTTTTGTAAG GAAAAGGGTATTGTTGTTGAAGCCTACTCACCATTGTTGGGAGTGCT AATGCTCCTTTACTAAAAGAGCAAGCAATTATTGATATGGCTAAA AAGCACGGCGTTGAGCCAGCACAGCTTATTATCAGTTGGAGTATT CAAAGAGGCTACGTTGTTCTGGCCAAATCGGTAAATCCTGAAAGA ATTGTATCCAATTTTAAGATTTTCACTCTGCCTGAGGATGATTTCA AGACTATTAGTAACCTATCCAAAGTGCATGGTACAAAGAGAGTCG TTGATATGAAGTGGGGATCCTTCCAATTTTCCAATGA (序列号 6 4)

[0213] 【表1-33】

[0214]

NCgl0324 / NP_599582.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MSISVKALQKSGPEAPFEVKIERRDPRADDVVIDIKAAGICHSDI HTIRNEWGEAHFPLTVGHEIAGVVSAVGSVDVTKWKVGDVGVGC LVNSCGECEQCVAGFENNCLRGVGTYSNDVDGTITQGGYAEK VVVNERFLCSIPEELNFDVAAPLLCAGITTYSPIARWNVKEGDKVA VMGLGGLGHMGVQIAAAKGA EVT VLSRSLRKAELAKELGAARTL ATSDDEFFTEHAGEFDFILNTISASIPVDKYLSLLKPHGVMAVVGL PPEKQPLSFGALIGGGKVL TGSNIGGIPETQEMLDFCAKHGLGAM IETVGVNDVDAAYDRV VAGDVQFRVVIDTASFAEVEAV (序列号 6 5)
碱基 序列	GTGAGTATCTCAGTAAAAGCACTACAAAAGTCCGGCCCAGAAGC ACCTTTCGAGGTCAAGATCATTGAACGCCGTGACCCACGCGCAG ATGATGTGGTTATTGATATCAAAGCTGCGGGCATCTGCCACAGCG ATATCCACACCATCCGCAACGAATGGGGCGAGGCGCACTTCCCG CTCACCGTCGGCCACGAAATCGCAGGCGTTGTCTCTGCGGTTGG ATCCGATGTAACCAAATGGAAAGTCGGCGACCGCGTGGGCGTCG GCTGCCTCGTTAACTCCTGCGGCGAATGCGAACAGTGCGTGCGCA GGATTTGAAAACAACTGCCTTCGCGGAAACGTGCGAACCTACAA CTCTAACGACGTCGACGGCACCATCACCCAAGGCGGCTACGCTG AAAAGGTAGTGGTCAACGAACGTTTCCTGTGCAGCATCCAGAG GAACTTAACTTCGATGTGCGCAGCACCCTGCTGTGCGCAGGCATC ACCACCTACTCCCAATCGCTCGCTGGAACGTAAAGAAGGCGA CAAAGTAGCAGTCATGGGCCTCGGCGGACTCGGACACATGGGTG TCCAGATCGCTGCAGCCAAGGGTGCTGAGGTTACCGTTCTGTCC CGTTCCCTGCGCAAGGCAGAACTTGCCAAGGAACTCGGCGCAGC TCGCACGCTTGCGACTTCTGATGAGGATTTCTTACCGAACACGC CGGTGAATTCGACTTCATCCTCAACACCATTAGCGCATCCATCCC AGTCGACAAGTACCTGAGCCTTCTCAAGCCACACGGTGTCATGG CTGTTGTGCGGTCTGCCACCAGAGAAGCAGCCACTGAGCTTCGGT GCGCTCATCGGCGGCGGAAAAGTCCTCACCGGATCCAACATTGG CGGCATCCCTGAAACCCAGGAAATGCTCGACTTCTGTGCAAAAC ACGGCCTCGGTGCGATGATCGAACTGTCGGCGTCAACGATGTT GATGCAGCCTACGACCGTGTTGTTGCCGGCGACGTTCAAGTTCCG CGTTGTCATTGATACTGCTTCGTTTGCTGAGGTTGAGGCGGTTTA G (序列号 6 6)

[0215] 【表1-34】

[0216]

NCgl0313 / NP_599571.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MSTVVPGIVALSKGAPVEKVNVPDPGANDVIVKIQACGVCHTD LAYRDGDISDEFPYLLGHEAAGIVEEVGESVTHVEVGDFVILNWR AVCGECRACKKGEPKYCFNTHNASKKMTLEDGTLESPALGIGAF EKT LVHEGQCTKVNPEEDPAAAGLLGCGIMAGLGA AVNTGDIKRG ESVAVFGLGGVGMAA IAGAKIAGASKIIAVDIDEKKLEWAKEFGAT HTINSSGLGGEGDASEVVA KVRELT DGFGTDV SIDAVGIMPTWQQ AFYSRDHAGRMVMVGVPNLTSRVDVPAIDFYGRGGSVRPAWYGD CLPERDFPTYVDLHLQGRFPLDKFVSERIGLDDVEEAFNTMKAGD VLRSVVEI (序列号 6 7)
碱基 序列	ATGAGCACTGTAGTG CCTGGAATTGTCGCACTGTCCAAGGGTGC ACCGGTAGAAAAAGTAAACGTTGTTGTCCCTGATCCAGGTGCTAA CGATGTCATCGTCAAGATTCAGGCCTGCGGTGTGTGCCACACCG ACTTGGCCTACCGCGATGGCGATATTT CAGATGAGTTCCCTTACC TCCTCGGCCACGAGGCAGCAGGCATTGTTGAGGAGGTAGGCGAG TCCGTCACCCACGTTGAGGTGCGCGATTT CGTCATCTTGA ACTGG CGTG CAGTGTGCGGCGAGTGCCGTGCATGTAAGAAGGGCGAGCC AAAGTACTGCTTTAACACCCACAACGCCTCTAAGAAGATGACCCT GGAAGACGGCACCAGCTGTCCCCAGCACTGGGTATTGGCGCGT TCTTGGA AAAAGACCCTGGTCCACGAAGGCCAGTG CACCAAGGTT AACCCTGAGGAAGATCCAGCAGCAGCTGGCCTTCTGGGTTGTGG CATCATGGCAGGCCTTGGCGCTGCGGTGAACACCGGTGATATTAA GCGTG GCGAGTCCGTAGCAGTCTTCGGCCTTGGTGGCGTGGGCA TGGCAGCTATTGCTGGCGCCAAGATTGCTGGCGCTTCCAAGATCA TTGCTGTTGATATCGATGAGAAGAAGCTGGAGTGGGCGAAGGAA TTCGGCGCAACCCACACCATTAATTCCTCTGGTCTTGGTGGCGAA GGTGATGCCTCTGAGGTCGTGGCAAAGGTTCTGTAGCTCACCGA TGGTTTCGGCACCGATGTCTCCATCGATGCGGTAGGCATCATGCC GACCTGGCAGCAGGCGTTTTACTCCCGTGACCATGCAGGCCGCA TGGTGATGGTGGGCGTTCCAAACCTGACGTCTCGCGTAGATGTT CCTGCGATTGATTTTTACGGTCGCGGTGGATCCGTGCGCCCTGCA TGGTACGGCGACTGCCTGCCTGAGCGTGATTTCCCAACTTATGTG GATCTGCACCTGCAGGGTCGTTTCCCACTGGATAAGTTTGTCTTCT GAGCGTATTGGTCTTGATGATGTTGAAGAGGCTTTCAACACCATG AAGGCTGGCGACGTGCTGCGTTCTGTGGTGGAGATCTAA (序列 号 6 8)

[0217] 【表1-35】

[0218]

NCgl0219 / NP_599475.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MPKYIAMQVSESGAPLAANLVQPAPLKSREVRVEIAASGVCHADI GTAAASGKHTVFPVTPGHEIAGTIAEIGENVSRWTVGDRVAIGWF GGNCGDCAFCRAGDPVHCRERKIPGVSYAGGWAQNIVVPAEALAA IPDGMDFYEAAPMGCAGVTTTFNALRNLKLDPGA AVAVFGIGGLVR LAIQFAAKMGYRTITIARGLEREELARQLGANHYIDSNDLHPGQA LFELGGADLILSTASTTEPLSELSTGLSIGGQLTIIGVDGGDITVSA AQLMMNRQIITGHLTGSANDTEQTMKFAHLHGVKPLIERMPLDQ ANEAIARISAGKPRFRIVLEPNS (序列号 69)
碱基 序列	ATGCCCAAATACATTGCCATGCAGGTATCCGAATCCGGTGCACCG TTAGCCGCGAATCTCGTGCAACCTGCTCCGTTGAAATCGAGGGA AGTCCGCGTGGAATCGCTGCTAGTGGTGTGTGCCATGCAGATAT TGGCACGGCAGCAGCATCGGGGAAGCACACTGTTTTCTCTGTTA CCCCTGGTCATGAGATTGCAGGAACCATCGCGGAAATTGGTGAA AACGTATCTCGGTGGACGGTTGGTGATCGCGTTGCAATCGGTTG GTTTGGTGGCAATTGCGGTGACTGCGCTTTTTGTCTGTCAGGTG ATCCTGTGCATTGCAGAGAGCGGAAGATTCCTGGCGTTTCTTATG CGGGTGGTTGGGCACAGAATATTGTTGTTCCAGCGGAGGCTCTT GCTGCGATTCCAGATGGCATGGACTTTTACGAGGCCGCCCGAT GGGCTGCGCAGGTGTGACAACATTCAATGCGTTGCGAAACCTGA AGCTGGATCCCGGTGCGGCTGTGCGGTCTTTGGAATCGGCGGT TTAGTGCGCCTAGCTATTCAGTTTGCTGCGAAAATGGGTATCGA ACCATCACCATCGCCCGCGGTTTAGAGCGTGAGGAGCTAGCTAG GCAACTTGCGCCAACCACTACATCGATAGCAATGATCTGCACCC TGGCCAGGCGTTATTTGAACTTGGCGGGGCTGACTTGATCTTGTC TACTGCGTCCACCACGGAGCCTCTTTCGGAGTTGTCTACCGGTCT TTCTATTGGCGGGCAGCTAACCATTATCGGAGTTGATGGGGGAGA TATCACCGTTTTCGGCAGCCCAATTGATGATGAACCGTCAGATCAT CACAGGTCACCTCACTGGAAGTGCGAATGACACGGAACAGACTA TGAAATTTGCTCATCTCCATGGCGTGAAACCGCTTATTGAACGGA TGCCTCTCGATCAAGCCAACGAGGCTATTGCACGTATTTTCAGCTG GTAAACCACGTTTCCGTATTGTCTTGGAGCCGAATTCATAA (序列 号 70)

[0219] 【表1-36】

[0220]

NCgl2709 / NP_601999.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MTTAAPQEFTA AVVEKFGHDVTVKIDIDLPKPGPHQALVKVLTSGI CHTDLHALEGDWVPVKPEPPFVPGHEGVGEVVELGPGEHDKVVG DIVGNAWLWSACGTCEYCITGRETQCNEAEYGGYTQNGSFGQYM LVDTRYAARIPDGV DYLEAAPILCAGVTVYKALKVSETRPGQFMVI SGVGGLGHIAVQYAAAMGMRVIAVDIADDKLELARKHGAFTVNA RNEDSGEAVQKYTNNGGAHGVLTAVHEAAFGQALDMARRAGTIV FNLPPGEFPASVFNIVFKGLTIRGSLVGTRQDLAEALDFFARGLI KPTVSECSLDEVNGVLDRMRNGKIDGRVAIRF (序列号 7 1)
碱基 序列	ATGACCACTGCTGCACCCCAAGAATTTACCGCTGCTGTTGTTGAA AAATTTCGGTCATGACGTGACCGTGAAGGATATTGACCTTCCAAAG CCAGGGCCACACCAGGCATTGGTGAAGGTACTCACCTCCGGCAT CTGCCACACCGACCTCCACGCCTTGGAGGGCGATTGGCCAGTAA AGCCGGAACCACCATTCGTACCAGGACACGAAGGTGTAGGTGAA GTTGTTGAGCTCGGACCAGGTGAACACGATGTGAAGGTTCGGCGA TATTGTCGGCAATGCGTGGCTCTGGTCAGCGTGTGGCACCTGCG AATACTGCATCACCGGCAGGGAAACTCAGTGCAACGAAGCTGAG TATGGTGGCTACACCCAAAATGGATCCTTCGGCCAGTACATGCTG GTGGATAACCGTTACGCCGCTCGCATCCCAGACGGCGTGGACTA CCTCGAAGCAGCACCAATTCTGTGTGCAGGCGTGACTGTCTACA AGGCACTCAAAGTCTCTGAAACCCGCCCGGGCCAATTCATGGTG ATCTCCGGTGTTCGGCGGACTTGGCCACATCGCAGTCCAATACGC AGCGGCGATGGGCATGCGTGTTCATTGCGGTAGATATTGCCGATGA CAAGCTGGAACCTTGCCCGTAAGCACGGTGCGGAATTTACCGTGA ATGCGCGTAATGAAGATTCAGGCGAAGCTGTACAGAAGTACACCA ACGGTGGCGCACACGGCGTGCTTGTGACTGCAGTTCACGAGGCA GCATTTCGGCCAGGCACTGGATATGGCTCGACGTGCAGGAACAAT TGTGTTCAACGGTCTGCCACCGGGAGAGTTCCCAGCATCCGTGT TCAACATCGTATTCAAGGGCCTGACCATCCGTGGATCCCTCGTGG GAACCCGCCAAGACTTGGCCGAAGCGCTCGATTTCTTTGCACGC GGACTAATCAAGCCAACCGTGAGTGAGTGCTCCCTCGATGAGGT CAATGGTGTGCTTGACCGCATGCGAAACGGCAAGATCGATGGTC GTGTGGCGATTTCGTTTCTAA (序列号 7 2)

[0221] 【表1-37】

[0222]

NCgl11112 / NP_600385.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MSLQFDHETLGQRVLFSGEAAQNLA AEISRLDAKNVMVVAGDF ELPMARQVAADIDVKVWHSNVVMHVPIETAEEARSVAKENDIDVV VCVGGGSTTGLAKAIAMTTALPIHAVPTTYAGSEATNVWGLTEAAR KTTGVDNKVLPVTVIYDSALTM SLPVEMSVASGLNGLAHCIDSLW GPKADPINAAMAAEGIRALSAGLPKIVADAQDVDGRDEALYGAYL AAVSFASAGSGLH HKICHVLGGTFNLPHAQTHATVLPYVLAFNAP YAPQAEQRAAAAFGSATALEGLQQLRAQVGAPQRLSDYGFTAAGI PEAVEIILEKVPANNPRTVTEENLTALLTTALNGDDPATLN (序列 号 7 3)
碱基 序列	ATGTCTTTACAGTTCGATCATGAAACCCTCGGTCAACGAGTTCTG TTCGGTTCAGGTGAGGCGGCGCAAATCTCGCCGCTGAAATTAG CCGACTCGATGCCAAAAACGTCATGGTGGTTGCCGGTGATTTCG AGCTTCCCATGGCACGGCAAGTAGCAGCAGATATTGATGTCAAGG TGTGGCATTCAAATGTCGTGATGCATGTGCCCATCGAAACAGCAG AAGAAGCACGCAGTGTTGCGAAAGAAAACGACATTGATGTTGTG GTGTGTGTGGGCGGTGGATCCACAACAGGTCTAGCTAAAGCGAT TGCCATGACCACCGCATTGCCGATCATTGCGGTACCCACTACTTA TGCAGGTTCTGAAGCAACAAATGTGTGGGGATTGACCGAAGCCG CGCGCAAAACAAC TGGTGTTGATAACAAAGTGCTGCCAGTGACA GTTATCTACGATT CAGCGTTAACCATGTCTTTGCCGGTAGAAATG TCGGTTGCTTCTGGTCTCAATGGTTTGGGCTCACTGCATTGATTCT TTGTGGGGACCGAAGGCGGATCCCATCAATGCGGCTATGGCTGC TGAGGGAATTCGAGCACTTTCTGCTGGCCTTCCCAAGATTGTGGC AGATGCTCAGGACGTAGATGGTCGCGATGAAGCGCTCTACGGTG CCTACCTGGCTGCGGTGTCTTTTGCTCTGCTGGCTCTGGTCTCC ACCACAAGATCTGCCACGTGTTGGGTGGAAC TTTAACCTTCCAC ACGCGCAAACCCATGCAACAGTACTGCCTTATGTTCTTGCCTTCA ACGCGCCATATGCGCCACAGGCAGAACAAACGCGCAGCGGCAGCT TTCGGTTCTGCGACAGCACTTGAAGGATTGCAACAGCTGCGTG CCAAGTGGGAGCACCACAGCGACTATCCGATTACGGATTCACCG CAGCAGGAATCCCAGAGGCAGTGGAATCATCTTGGAGAAAGTA CCGGCGAATAATCCACGGACGGTCACAGAAGAAAACCTCACTGC GCTGCTTACCACAGCGCTCAACGGCGACGATCCAGCAACTTTGA ATTAA (序列号 7 4)

[0223] 【表1-38】

[0224]

NCgl2382 / NP_601669.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MQTLAAIVRATKQPFEITTIDLDAPRPDEVQIRVIAAGVRHTDAIV RDQIYPTFLPAVFGHEGAGVVVAVGSAVTSVKPDDKVVVLGFNSCG QCLKCLGGKPAYCEKFYDRNFACTRDAGHTTLFTRATKEQAEAI DTLDDVFYDADAGFLAYPATPPEASGVSVLVVAAGTSDLPQAKEA LHTASYLGRSTSLIVDFGVAGIHRLLSYEEELRAAGVLIVAAGMDG ALPGVVAGLV SAPVVALPTSVGYGAGAGGIAPLLTMLNACAPGVG VVNIDNGYGAGHLAAQIAAR (序列号 7 5)
碱基 序列	ATGCAAACCCTTGCTGCTATTGTTTCGTGCCACGAAGCAACCTTTT GAGATCACCACCATTGATCTGGATGCACCACGACCAGATGAAGTT CAAATCCGTGTTATTGCTGCCGGAGTGCGCCACACTGACGCAATT GTTCGTGATCAGATTTACCCAACTTTTCTTCCCGCAGTTTTTCGGC CACGAAGGCGCCGGAGTAGTTGTCGCCGTGGGTTCTGCAGTCAC CTCGGTGAAACCAGATGACAAGGTAGTGCTGGGATTCAACTCTT GTGGCCAGTGCTTGAAGTGTTTGGGCGGTAAGCCTGCGTACTGT GAGAAATTCTATGACCGCAACTTCGCATGCACCCGCGATGCCGG GCACACTACTTTGTTTACCCGTGCAACAAAAGAGCAGGCAGAGG CCATCATCGACACCCTTGATGATGTTTTCTACGATGCGGATGCGG GTTTCCTGGCATACCAGCAACTCCCCCAGAGGCTTCGGGAGTA AGCGTGTTGGTTGTCGCGGCTGGTACCTCTGATCTCCCCAAGC AAAGGAAGCACTACACACTGCCTCCTACTTGGGGCGCTCCACCT CACTGATTGTTGATTTTGGAGTGGCTGGCATCCACCGCCTGCTTT CATA CGAAGAAGAACTCCGCGCTGCGGGCGTGCTCATCGTTGCC GCTGGAATGGATGGTGCGCTACCCGGAGTTGTCGCAGGCTTAGT GTCCGCACCTGTCGTCGCACTGCCAACCTCCGTGGGATACGGCG CAGGTGCTGGAGGAATCGCACCACTTCTGACCATGCTTAACGCCT GCGCGCCGGGAGTTGGAGTGGTCAACATTGATAACGGCTATGGA GCAGGACACCTGGCTGCGCAGATTGCGGCGAGGTAA (序列号 7 6)

[0225] 【表1-39】

[0226]

NCgl0186 / NP_599442.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MLNAVGKAQNILLGGTSEIGISIVSRFLKQGPPSHVTLAARKDSPR VDAVAEIKAAAGASVAVVDFDALDTESHPAAIDAAFENGDDVDVAI VAFGILGDNEAQWRDQALAVEATTVNYTAGVSVGVLLGQKFEQQ GHGTIVALSSVAGQVRVRSNFVYGSAKAGFDGFYTLGEALRGSG ANVLVVRPGQVRTKMSADGGEAPLTVNREDVADAVYDAVVNKKD IIFVHPLFQYVSFAFQFIPRAIFRKLPF (序列号 77)
碱基 序列	ATGCTTAACGCAGTGGGCAAAGCCCCAAAACATTCTCCTTCTTGGT GGAACCTCTGAGATCGGTATTTCCATTGTCTCCCGCTTCTCAAG CAGGGTCCATCCCATGTGACCTTGGCAGCGCGTAAAGATTCCCCA CGCGTGGACGCAGCAGTCGCAGAGATCAAAGCAGCTGGCGCTGC TTCCGTTGCTGTTGTTGATTTTCGATGCGCTCGACACCGAATCCCA CCCTGCAGCCATCGACGCAGCCTTTGAAAACGGCGACGTTGACG TAGCAATCGTGGCTTTTCGGCATCCTCGGCGACAACGAAGCACAG TGGCGCGACCAAGCACTAGCAGTGGAAGCAACCACCGTGAACCTA CACCGCCGGCGTTCCTAGGTGTACTGCTGGGCCAGAAATTTG AGCAGCAGGGCCACGGCACCATCGTGGCATTGTCTCTGTGGCA GGCCAGCGAGTCCGCGCTCCAACCTTGTCTACGGCTCCGCCAA GGCAGGTTTCGACGGTTTCTACACCCAGCTCGGCGAAGCCCTGC GTGGATCCGGTGCCAACGTATTGGTGGTTCGCCAGGCCAGGTA CGCACCAAGATGTCCGCAGATGGTGGCGAAGCCCCACTGACCGT CAACCGCGAAGACGTGGCAGATGCTGTTTATGATGCAGTGGTGA ACAAGAAGGACATCATCTTTGTCCACCCACTGTTCCAGTACGTCT CTTTTGCGTTCCAATTCATTCCGCGAGCAATCTTCCGCAAGCTGC CGTTCTAA (序列号 78)

[0227] 【表1-40】

[0228]

NCgl0099 / NP_599352.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MEHGVTVIKGTDFDVFPLNLGGNTFGWTSNREQTFVLDAFVAA GGNFVDTADSYSAWVEGNEGGERELGAWIKERGADKLIATKS GALEPVAGRSREATFKAVEGSLERLGVESIDIFYHYDDEAVSIDE QVAIANDLIAQGKIKHLALSNSYAERLAEFFEKSVGTPAQPVALQP HYNLVS RKDYEENVQPLAEKHGVAVFPYFALAAGLLTGKYTSKED ISGKARAGQLDRYASDEAFVVTTELRAVADELGVAPTTVALAWLVA HGVTAPIASVSKVEQLKDLMAVKDVELSAEQLARLDKVSEPF (序列号 79)
碱基 序列	ATGGAGCACGGCGTGACCGTTATTAAAGGCACTGAATTTGATGTT TTCCCACTAAACCTCGGTGGAAATACCTTTGGCTGGACCTCGAAT AGGGAACAGACCTTCGCGGTTTTGGATGCATTCGTGGCAGCGGG AGGAACTTTGTTGACACCGCCGATTCTTATTCTGCATGGGTTGA AGGCAATGAGGGTGGCGAGTCGGAGCGGGAGCTCGGCGCGTGG ATTAAGGAACGTGGCGCAGACAAGCTGATCATTGCTACCAAGTCT GGTGC GTTGGAGCCTGTTGCTGGTCGTTCCCGTGAGGCAACTTT CAAGGCTGTGAGGGTTCCCTGGAGCGTTTGGGCGTGGAATCGA TCGATATTTTTTACTACCACTACGACGATGAGGCAGTCAGCATTG ATGAGCAGGTTGCTATCGCTAATGATCTGATTGCACAGGGCAAGA TTAAGCACCTCGCATTGTCTAACTACAGCGCGGAGCGTTTAGCTG AGTTCTTTGAGAAGTCTGTAGGCACTCCAGCGCAGCCGGTTGCT CTGCAACCGCACTACAACCTGGTGTCGAGGAAGGATTATGAGGA GAACGTGCAGCCACTCGCCGAGAAGCATGGCGTTGCAGTCTTCC CTTATTTTCGCGCTTGCCGCGGGTCTTTTGACCGGAAAGTACACCT CCAAGGAGGATATTTTCGGGTAAAGCGCGTGCGGGGCAGTTGGAT CGTTACGCCAGCGATGAGGCGTTTGCCGTGGTGACAGAGTTGCG TGCTGTTGCCGATGAGTTGGGTGTTGCGCCAACGACTGTGGCGC TTGCGTGGTTGGTTGCGCATGGTGTGACCGCACCGATTGCGTCC GTGTCCAAGGTAGAGCAGTTGAAGGATTTGATGGCTGTGAAGGA TGTGGAGCTGAGCGCTGAGCAGCTTGACGTTTGGATAAGGTTT CGGAGCCTTTCGCTTAA (序列号 80)

[0229] 【表1-41】

[0230]

NCgl2952 / NP_602249.1 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MNNSLAFNHD TLPQKVMFGY GKSSAFLKQEVERRGSAKVMVIAG EREMSI AHKVASEIEVAIWHDEVVMHVP IEVAERARAVATDNEIDL LVCVGGGSTIGLAKAIAMTTALPIVAIPTTYAGSEATNVWGLTEAA RKT TGVDLKVLPETVIYDSELTMSLPVEMSVASGLNGLAHCIDSL WGP NADPINAVLAAEGIRALNQGLPKIVANPHSIEGRDEALYGAYL AAVSFASAGSGLHHKICHTLGGTFNLPHAQTHATVLPYVLAFNAG DAPEAERRAAAAFGTDTALEGLQRLRLSVNAPKRLSDYGFEASGI AEA VDV TLEKVPANNPRPVTRENLSRLLEAALNGEDPAVLSAVLS N (序列号 8 1)
碱基 序列	GTGAACA AACTCACTCGCATTCAACCACGACACCCTCCACAGAAA GTCATGTTTGGATATGGCAAGTCCAGTGCATTCTTAAAGCAGGAA GTTGAACGCCGCGGCTCAGCCAAGGTCATGGTCATTGCGGGTGA ACGAGAAATGTCGATCGCCCATAAAGGTGGCCTCAGAAATTGAGG TGGCGATCTGGCACGACGAAGTTGTCATGCACGTGCCCATCGAA GTAGCCGAACGTGCGCGTG CAGTGGCAACCGACAATGAGATTGA TCTGCTGGTGTGTGTTGGCGGCGGATCCACCATAGGTTTGGCCA AAGCAATTGCCATGACCACTGCCCTGCCCATCGTCGCGATCCCCA CCACCTACGCAGGATCGGAAGCAACCAACGTGTGGGGTCTGACG GAAGCAGCGCGCAAAACAACCGGTGTTGATCTGAAGGTGCTCCC CGAAACAGTCATTTACGATTCCGAACCTCACCATGTCGCTTCCAGT GGAGATGTCCGTGGCATCCGGA CTCAACGGCCTGGCGCACTGCA TTGATTCTTTGTGGGGACCCAACGCCGATCCCATCAACGCAGTGC TTGCAGCCGAAGGAATCCGCGCACTCAACCAGGGACTGCCGAAA ATTGTTGCGAACCCGCACAGCATCGAAGGACGCGACGAAGCCCT CTACGGCGCCTACCTCGCAGCAGTATCCTTCGCCTCCGCAGGCTC CGGACTACACCACAAAATCTGCCACACCTTGGGAGGCACCTTCA ACCTCCCCACGCCCAAACCCACGCAACCGTGCTGCCGTATGTTT TGGCATTCAACGCAGGCGACGCACCAGAAGCTGAACGCCGCGCA GCCGCAGCCTTTGGA ACTGACACCGCACTAGAAGGCCTGCAACG CCTCCGCTTGTCAGTCAACGCACCGAAACGACTTTCCGACTACG GCTTCGAGGCTTCAGGAATTGCTGAGGCAGTGGACGTCACGTTG GAGAAAGTTCCCGCCAACAATCCTCGCCCAGTGACCCGGGAAAA CCTCAGCAGATTGCTCGAAGCAGCACTCAACGGTGAGGATCCGG CAGTTCTTAGCGCAGTACTCAGTAACTAA (序列号 8 2)

[0231] 【表1-42】

[0232]

NCgl1459 / NP_600732.2 / <i>Corynebacterium glutamicum</i> ATCC 13032	
氨基酸 序列	MKQRMVGSSGLRVSRLGLGTSTWGSGETELAEAGDIFKAFINSGGT LIDVSPNYTTGVAEEMLGTM LDAEVSRSAVVISSAGVNPALPLGR RVDCSRRLIAQLDVTLRALNTDYLDLWSVGYWDEGTPPHEVADT LDYAVRTGRVRYAGVRGYSGWQLAVTHAASNHAAASARPVVVAQN EYSLLERRAEQELLPATQHLGVGFFAGAPLGQGVLTAKYRSEIPH DSRAASTGRDAEVQSYLDNRGRIIVDALDTAAKGLGISPAVTATTW VRDRPGVTAVIVGARTHEQLSHLLKAESVTLPTPITQALDDVSL (序列号 8 3)
碱基 序列	GTGAAACAGCGAATGGTCGGTTCAAGTGGTTTGCGGGTATCCAG GCTCGGTTTGGGCACCTCAACATGGGGCTCGGGCACCGAGCTGG CTGAGGCAGGCGATATCTTTAAGGCGTTCATCAATTCTGGTGGCA CGCTTATCGACGTCTCCCCCAACTACACCACCGGCGTCGCGGAA GAAATGCTCGGCACGATGTTGGATGCGGAAGTCTCTCGTTCGGC TGTCGTCATTTCTCCAGCGCAGGTGTCAACCCCGCTCTGCCGCT CGGCCGACGTGTGGATTGCTCCCGCCGCAATTTGATTGCCCAATT AGATGTCACCCTGCGGGCATTAAACACTGACTATTTGGATTTGTG GTCTGTGGGCTATTGGGATGAGGGCACCCACCGCATGAGGTGG CCGATACTTTGGATTACGCCGTGCGCACCGGCCGAGTCCGATATG CCGGTGTCCGAGGATATTCCGGTTGGCAGTTAGCGGTACCCAC GCTGCATCCAATCATGCAGCGGCCTCCGCCCGCCCCGTGGTTCGT TGACACAAAATGAATACAGCCTGCTGGAACGCCGCGCAGAACAAAG AACTCCTCCCTGCCACCCAACACCTAGGTGTGCGGATTCTTTGCTG GCGCTCCGCTGGGGCAAGGCGTGCTGACTGCTAAATACCGCTCC GAAATTCCCCATGATTCCAGAGCTGCATCCACAGGACGCGACGC AGAAGTCCAAAGCTACCTAGATAATCGAGGCCGCATCATTGTCGA TGCTCTTGATACTGCAGCCAAAGGATTAGGCATTAGCCCCGCTGT CACAGCCACCACCTGGGTGCGTGATCGTCCCGGAGTGACAGCTG TCATCGTGGGCGCTCGCACACATGAACAGCTGTCACATCTTCTCA AGGCGGAATCGGTGACTTTGCCAACACCAATCACACAAGCCCTT GATGATGTCTCCCTGTGA (序列号 8 4)

[0233] 【表1-43】

[0234]

yogA / NP_389725.1 / Bacillus subtilis subsp. subtilis str. 168	
氨基酸 序列	MKAVIHNGKAGLLGLSVQDVPSTKPGYGEVKVKLKSAGLNHRDL FLMKNKSEQDPHMILGSDGAGIIEEIGEGVKNVTQTEVVIFPTL NWDLTENVPPVPEILGGPSDGTAEYVIIPSQNAIKKPAYLSWEEA GVLPLSALTAYRALFTKGQLKKGEHLLIPGIGSGVATYALFMAKAI GATVSVTSRSEEKRRKKALKLGADYAFDSYSNWDEQLQGKKIDVVL DSIGPALFSEYFRHVKPNGRIVSFGASSGDNLSFPVRSLFPPQVNV LGTSMSGSEEFQAMLA FIDKHKLRPVIDRIYPLEKACEAYKRMQE GRQFGNIGIVME (序列号 8 5)
碱基 序列	ATGAAAGCTGTAATTCACAACGGAAAAGCCGGTCTTCTGGGGTTA TCAGTTCAGGACGTTCCATCAACAAAGCCTGGATACGGAGAGGT AAAGGTAAATTAATAATCTGCAGGCCTGAATCATCGTGACTTGTT TCTTATGAAAAACAAATCTGAACAAGATCCTCACATGATACTGGG TTCTGACGGCGCGGGTATCATCGAAGAGATTGGTGAAGGCGTGA AAAATGTTACTGTTTCAGACAGAAGTAGTCATTTTCCCGACATTGA ACTGGGATTTGACAGAAAATGTTCCACCTGTACCTGAGATTCTGG GAGGTCCTTCGGACGGAACACTTGCTGAATATGTGATCATTCCTT CACAAAATGCAATCAAAAAACCTGCTTATTTATCTTGGGAAGAAG CGGGCGTTTTACCTTTATCCGCTTTAACTGCATATCGGGCTCTGT TTACAAAGGGGCAATTAAAAAAAGGCGAGCATCTATTGATACCCG GCATCGGCAGCGGTGTAGCAACCTACGCTTTATTTATGGCTAAGG CGATTGGGGCAACAGTAAGCGTGACCTCCCGCAGTGAGGAGAAA AGAAAAAAGGCGCTGAAATTAGGTGCTGATTACGCATTTGACAGC TACAGCAATTGGGATGAGCAGTTGCAGGGAAAAAAGATAGATGTT GTTCTTGACAGCATAGGACCTGCCCTCTTTTCGGAATACTTCCGC CATGTAAAACCAAATGGCCGTATTGTCAGCTTTGGGGCAAGCTCA GGGGATAATCTCAGTTTTCCGGTGCGTTCTTTATTCTTTCCTCAG GTCAATGTTTTGGGAACCTCGATGGGAAGCGGTGAGGAATTTCA AGCTATGCTCGCTTTCATTGACAAACATAAGCTGCGGCCTGTAAT TGACCGGATATATCCTTTAGAAAAAGCATGTGAAGCATATAAAAG AATGCAGGAAGGCAGACAGTTTGGAACATCGGGATCGTAATGG AATAA (序列号 8 6)

[0235] 【表1-44】

[0236]

bdhK / NP_391014.1 / Bacillus subtilis subsp. subtilis str. 168	
氨基酸 序列	MENFTYYNPTKLIFGKGQLEQLRKEFKRYGKNVLLVYGGGSIKRN GLYDQVTGILKEEGAVVHELSGVEPNPRLATVEKGIGLCREHDID FLLAVGGGSVIDCTKAIAAGVKYDGDWDIFSKKVTAEDALPFGT VLTAAATGSEMNPDSVITNWETNEKFVWGSNVTHPRFSILDPE FTVPENQTVYGMVDMMSHVFEQYFHNVENTPLQDRMCFVLQT VIETAPKILLEDLENYELRETILYAGTIALNGTLQMGYFGDWASHT MEHAVSAVYDIPHAGGLAILFPNWMRYTLDTNVGRFKNLMLNMF DIDTEGKTDKEIALEGIDKLSAFWTSLGAPSRLADYNIGEEKLELI ADIAAKEMEHGGFGNFQKLNKDDVLAIRASL (序列号 87)
碱基 序列	ATGGAAAATTTCACTTATTATAATCCGACAAAGCTGATTTTTTGAA AAGGTCAGCTTGAACAATTAAGAAAAGAATTCAAACGATACGGCA AGAATGTACTGCTTGTTACGGGGGCGGCAGCATTAAACGCAAC GGCCTTTATGATCAAGTCACAGGCATTTTAAAAGAAGAGGGCGCT GTTGTTTCATGAGCTGTCAGGTGTAGAGCCAAACCCGCGTCTTG GACAGTGGAAAAAGGCATAGGACTTTGCAGAGAGCATGACATTG ATTTTCTGCTTGCTGTCGGCGGAGGCAGTGTGATTGACTGTACAA AGGCAATCGCAGCTGGCGTCAAATATGACGGTGACGCTTGGGAT ATTTTCAGCAAAAAAGTAACAGCGGAGGATGCGCTGCCGTTTGG CACTGTTTTAACTCTTGCTGCAACAGGGTCTGAAATGAACCCTGA TTCCGTGATTACAACTGGGAAACAAACGAGAAATTTGTATGGGG CAGCAATGTCACTCATCCGCGTTTCTCTATTTTAGACCCTGAAAA TACGTTACCGTTCCAGAAAATCAAACAGTATACGGCATGGTTGA CATGATGAGCCACGTATTCGAACAATACTTCCATAATGTTGAAAA CACGCCGCTTCAGGATAGAATGTGCTTTGCTGTTTTGCAGACGGT CATCGAAACAGCTCCTAAGCTTCTTGAAGATCTGGAAAACCTACGA ACTTCGTGAAACGATTTTGTATGCTGGTACTATTGCTTTAAACGG CACGCTCCAAATGGGATACTTCGGTGACTGGGCTTCTCATACAAT GGAACACGCTGTTTCAGCTGTATATGATATTCCGCACGCGGGCGG TTTGGCAATACTGTTCCCAAATTGGATGAGATACACGCTTGATAC AAATGTAGGCCGTTTTTAAAAACCTTATGCTCAACATGTTTGACAT TGATACTGAAGGCAAAACAGATAAAGAAATTGCGCTTGAAGGAAT CGATAAACTGTCTGCGTTCTGGACAAGCCTCGGTGCACCTTCTCG TCTTGCTGATTACAATATTGGAGAAGAAAAGCTTGAGCTGATTGC TGATATCGCAGCCAAGGAAATGGAACACGGCGGCTTCGGCAACT TCCAAAACTGAACAAAGATGACGTGCTTGCCATCCTTCGCGCGT CTCTATAA (序列号 88)

[0237] 【表1-45】

[0238]

bdhJ / NP_391015.1 / Bacillus subtilis subsp. subtilis str. 168	
氨基酸 序列	MQNFTYWNPTKLIFGRGEVERLPEELKPYGKNVLLVYGGGSIKRS GLYDQVIEQLNKAGATVHELAGEPNPRVSTVNKGVAICKEQNID FLLAVGGGSVIDCTKAIAAGAKYDGDWDIVTKKHQPKDALPFGT VLTAAATGSEMNSGSVITNWETKEKYGWGSPLVFPKFSILDPVNT FTVPKNHTIYGMVDMMSHVFEQYFHHVSNTPTYQDRMCESLLRTV IETAPKLINDLENYELRETILYTGIALNGMLSMGARGDWATHNIE HAVSAVYDIPHAGGLAILFPNWMRHTLSENPARMKQLAVRVFDVE EAGKTDEEIALEGIDKLSAFWTSLGAPNRLADYDINDEQLDTIAD KAMANGTFGQFKSLNKEDVLSILKASL (序列号 89)
碱基 序列	ATGCAAACTTTACATACTGGAATCCGACCAAATTAATTTTCGGG CGCGGCGAAGTGGAAGACTTCCGGAGGAACTCAAACCTTACGG AAAAAACGTATTGCTTGTGTACGGAGGCGGCAGCATTAAACGCA GCGGCCTGTATGATCAAGTGATTGAACAGCTGAATAAAGCCGGA GCGACCGTGCATGAATTAGCAGGTGTGGAACCGAATCCTCGTGT GTCGACTGTTAATAAAGGTGTTGCCATCTGTAAAGAACAAAACAT TGATTTCTTGCTGGCTGTCCGAGGCGGAAGCGTAATCGACTGTAC AAAAGCGATTGCCGCAGGAGCGAAGTATGATGGTGATGCGTGGG ATATCGTTACGAAAAAGCATCAGCCAAAAGATGCTTTGCCATTTCG GAACGGTATTGACTCTCGCTGCAACTGGTTCAGAAATGAACTCAG GATCTGTTATTACAACTGGGAAAACAAAAGAAAAATACGGCTGGG GCAGCCCGCTCGTATTCCCTAAATTCTCGATTCTTGATCCGGTGA ATACATTCACCGTACCTAAAAACCACACGATCTACGGGATGGTTG ACATGATGAGCCACGTATTCGAACAATACTTCCATCATGTATCAA ACACGCCGTATCAGGACCGCATGTGTGAATCACTTTTGCGTACAG TCATTGAAACAGCGCCTAAGCTGATCAATGATCTCGAAAATTACG AATTGCGTGAGACGATCCTGTACACAGGAACAATCGCATTAACG GCATGCTTTCTATGGGGGCAAGAGGGGATTGGGCTACTCATAATA TTGAACATGCAGTATCAGCCGTTTATGATATTCGCATGCCGGCG GACTGGCGATTCTGTTCCCGAATTGGATGAGACACACATTGTCTG AAAACCCTGCCCGCATGAAACAGCTTGCAGTTCGCGTGTGTTGATG TTGAAGAAGCAGGTAAAACGGATGAAGAAATTGCCCTTGAAGGT ATCGATAAGCTGTCCGCATTCTGGACAAGTCTTGGCGCTCCGAAC CGTCTTGCTGATTATGATATTAATGATGAGCAGCTTGACACAATC GCTGACAAGGCAATGGCTAACGGTACATTCCGGCCAATTTAAATCA CTCAACAAAGAAGATGTGCTGTCAATTTTGAAAGCATCACTATAA (序列号 90)

[0239] 【表1-46】

[0240]

akrN / NP_388834.1 / Bacillus subtilis subsp. subtilis str. 168	
氨基酸 序列	MEYTSIADTGIEASRIGLGTWAIGGTMWGGTDEKTSIETIRAALDQ GITLIDTAPAYGFGQSEEIVGKAIKEYGKRDQVILATKTALDWKNN QLFRHANRARIVEEVENSLKRLQTDYIDLYQVHWPDPPLVPIEETA EVMKELYDAGKIRAIGVSNFSIEQMDTFRAVAPLHTIQPPYNLFR EMEESVLPYAKDNKITLLYGSLCRGLLTGKMT E EYTFEGDDL RN HDPKFQKPRFKEYLSAVNQLDKLA KTRYGKSVIHLAVRWILDQPG ADIALWGARKPGQLEALSEITGWTLNSEDQKDINTILENTISDPVG PEFMAPPTREEI (序列号 9 1)
碱基 序列	ATGGAATATACCAGTATAGCAGATACAGGAATAGAAGCCTCCAGA ATCGGCCTCGGCACATGGGCCATTGGCGGAACGATGTGGGGAGG CACTGACGAAAAACATCGATTGAAACAATCCGCGCCGCTCTTGA TCAGGGGATTACACTGATTGACACCGCACCGGCTTACGGCTTCG GGCAGTCCGAGGAAATTGTCTCGGAAAGGCAATCAAAGAGTACGGC AAAAGAGACCAGGTGATTCTCGCAACGAAAACGGCTCTGGACTG GAAGAACAACCAGCTGTTCCGCCATGCGAACAGAGCGAGAATTG TAGAGGAAGTTGAGAATTCTTTGAAGCGGCTTCAAACAGACTATA TTGATCTTTATCAGGTGCATTGGCCCGATCCGCTTGTGCCAATTG AAGAAACGGCTGAAGTCATGAAGGAATTATATGATGCGGGAAAAA TCCGGGCGATTGGCGTCAGCAATTTTTCAATTGAGCAAATGGATA CATTTTCGCGCCGTCGCACCTCTCCATACGATTCAGCCTCCATATA ATCTGTTTGAAAGAGAGATGGAAGAGAGTGTCCTTCCTTATGCGA AAGATAACAAGATAACAACATTATTATACGGCAGTTTATGCAGAG GGCTGTTAACAGGCAAAATGACTGAAGAATATACATTTGAGGGCG ATGATCTGCGTAATCACGATCCAAAATTCCAGAAGCCCCGCTTTA AAGAGTATCTTTCTGCTGTGAATCAATTGGATAAGCTGGCGAAGA CACGTTATGGAAAATCAGTGATTCACTTGGCTGTCAGATGGATCT TAGATCAGCCGGGAGCGGATATCGCTCTTTGGGGAGCAAGAAAG CCTGGGCAGCTTGAGGCCCTATCTGAGATTACAGGCTGGACGCT GAACAGTGAAGATCAGAAAGATATCAATACTATATTGGAAAATAC GATATCAGACCCTGTCGGACCGGAGTTTATGGCCCCGCGACCA GAGAGGAAATATAA (序列号 9 2)

[0241] 【表1-47】

[0242]

yqkF / NP_390243.1 / Bacillus subtilis subsp. subtilis str. 168	
氨基酸 序列	MRKRKLGTSDDLISEVGLGCM SLGTEKNKALSILDEAIELGINYL DTADLYDRGRNEEIVGDAIQNRRHDIILATKAGNRWDDGSEGWY WDPSKAYIKEAVKKS LTRLKTDYIDLYQLHGGTIEDNIDETIEAFE ELKQEGVIRYYGISSIRPNVIKEYVKKSNI VSIMMQFSLFDRRPEE WLPLLEEHQISVVARGPVAKGLLTEKPLDQASESMKQNGYLSYSF EELTNARKAMEEVAPDLSMTEKSLQYLLAQPAVASVITGASKIEQL RENIQAANARRLTEEEIKALQSHTKQDIYKAHRS (序列号 9 3)
碱基 序列	ATGAGAAAGCGCAAATTGGGTACATCTGATTTAGACATTAGCGAA GTCGGACTCGGCTGTATGTCTCTTGGA ACTGAAAAAACA AAGC ATTGTCCATTCTGGATGAAGCGATCGAGCTTGGCATCAACTATTT GGACACAGCGGATTTGTATGACCGGGGACGCAATGAAGAAATTG TCGGTGATGCGATCCAAAACAGACGCCATGATATTATTCTGGCAA CAAAAGCGGGAAACCGTTGGGATGACGGAAGCGAGGGCTGGTAT TGGGACCCTTCAAAAGCTTACATAAAAGAGGCGGTAAAAAAGAG CCTTACACGTCTGAAAACAGATTATATCGACCTTTATCAGCTCCA CGGCGGCACGATAGAGGACAACATTGATGAAACGATTGAAGCGT TTGAGGAATTAACAAGAAGGTGTCATCCGCTACTACGGCATT CTTCCATCCGCCC GAATGTGATTAAAGAATATGTAAAAAATCAA ACATCGTCAGCATTATGATGCAATTCAGCCTGTTTGACAGACGCC CTGAGGAATGGCTCCCGCTTTTAGAGGAACATCAAATCAGCGTAG TCGCCAGAGGTCCTGTTGCCAAAGGGCTCTTA ACTGAAAAACCG CTTGATCAAGCTTCAGAAAGTATGAAACAAAACGGGTACTTGTCC TATTCATTCGAGGAACTGACAAATGCCCGTAAGGCAATGGAGGAA GTGGCTCCCGATCTTTCATGACAGAAAAGTCGCTGCAGTATCTG CTAGCACAGCCGGCTGTCGCTTCAGTGATTACAGGCGCCAGTAA GATTGAGCAGTTACGGGAAAATATTCAGGCAGCAAATGCACGGC GTTTAACCGAAGAGGAAATCAAAGCGCTCCAATCTCATACGAAAC AAGACATTTACAAAGCTCATCGCTCATAG (序列号 9 4)

[0243] 【表1-48】

[0244]

yccK / NP_388159.1 / Bacillus subtilis subsp. subtilis str. 168	
氨基酸 序列	MDQTRTLGKTKLKVKRIGFGANAVGGHNLFPNLNDETGKDLVRT ALDGGVNFIDTAFIYGLGRSEELIGEVVQERGVRELIIATKGAHK EVDGSIELDNSREFLRSEVEKSLKRLKTDYIDLYYVHFDPGKTPLA EVAGTLKELKDEGKIKAIASNLDYQQLQDFNADGYLEVFAQEYS LIQRDAEKELLPYCEKQGISFIPYFPLASGLLTGKFTQDTVFDFFR KDKPQFQGETFIHNLKKVVDKLKAVAEKQADTAHVALAWLLTRPA IDAIIPGAKRPEQLQDNLKTLNIELTEDEVNFISDIFK (序列号 9 5)
碱基 序列	ATGGATCAAACACGTACACTCGGCAAAACGAAGCTGAAGGTGAA GCGGATCGGATTCGGCGCGAATGCGGTCGGCGGGCATAATCTAT TTCCAAATCTAAATGATGAAACAGGGAAGGATTTAGTGCGCACGG CATTGGATGGCGGCGTCAATTTTATCGATACCGCCTTTATATATGG ATTGGGGCGATCTGAAGAATTAATCGGCGAAGTCGTACAGGAAC GCGGCGTGCGGAATGAGCTCATCATCGCCACCAAAGGAGCTCAT AAAGAAGTGGACGGCAGCATTGAATTAGACAATAGCCGGGAGTT TCTTCGCAGCGAGGTGGAGAAGAGCCTGAAGCGGCTGAAAACAG ATTACATTGATTTGTATTATGTTCACTTTCCGGATGGAAAAACACC TCTCGCTGAAGTGGCGGGCACTTTGAAAGAGCTGAAGGATGAGG GGAAAATCAAAGCGATCGGCGCTTCGAACCTCGATTATCAGCAAT TGCAGGATTTTAATGCTGACGGCTATTTGGAGGTCTTCCAGGCCG AATATTCTCTCATAACAGCGTGATGCCGAGAAAGAGCTTCTTCCAT ACTGTGAAAAACAAGGCATCTCCTTTATTCCTTACTTTCCGCTTG CGTCCGGACTGCTGACAGGAAAATTCACGCAAGACACAGTCTTT GATGATTTTCAGAAAGGATAAACCTCAATTTTCAGGGTGAAACGTTT ATCCACAATCTCAAAAAAGTAGATAAGCTGAAAGCAGTAGCGGAG GAAAAACAAGCGGATACGGCACATGTCGCCTTGGCGTGGCTGTT AACGAGACCGGCGATTGATGCCATTATTCCAGGAGCTAAACGACC GGAGCAATTACAGGATAACCTGAAAACCTTGAACATTGAACTGAC CGAAGATGAAGTGAATTTTCATCAGCGACATTTTCAAATAA (序列 号 9 6)

[0245] 【表1-49】

[0246]

iolS / NP_391857.1 / Bacillus subtilis subsp. subtilis str. 168	
氨基酸 序列	MKKAKLGKSDLQVFPIGLGTNAVGGHNLYPNLNEETGKELVREAI RNGVTMLDTAYIYGIGRSEELIGEVLREFNREDVVIATKAAHRKQ GNDFVFDNSPDLKKSVDLSKRLNTDYIDLFIHFPDEHTPKDE AVNALNEMKKAGKIRSIGVSNFSLEQLKEANKDGLVDVLQGEYNL LNREAEKTFFPYTKEHNISFIPYFPLVSGLLAGKYTEDTTFPEGDL RNEQEHFKGERFKENIRKVNKLAPIAEKHNVDPHIVLAWYLARP EIDILIPGAKRADQLIDNIKTADVTLSEQEDISFIDKLFA (序列号 9 7)
碱基 序列	ATGAAAAAAGCGAAGCTCGGAAAATCAGACTTGCAGGTATTCCCT ATCGGATTAGGAACAAATGCTGTCTCGGAGGACATAACCTCTACCCG AACCTAAATGAAGAAACCGGAAAAGAATTGGTGCAGGAGGCGAT CCGTAATGGCGTGACAATGTTAGACACCGCTTACATTTACGGGAT CGGCCGTTCCGAAGAATTAATTGGTGAAGTGCTGCGTGAATTCAA CCGTGAAGATGTTGTCTATCGCGACAAAAGCCGCTCACAGAAAAC AAGGCAATGACTTTGTCTTTGATAATTCACCAGATTTTCTTAAAA AATCAGTTGATGAAAGCCTGAAGCGCTTGAATACCGATTATATTG ATTTGTTCTACATTCACCTCCCTGACGAACATACGCCTAAGGATG AAGCCGTTAACGCGCTGAATGAGATGAAGAAAGCCGGAAAAATC CGTTCCATCGGTGTATCCAACCTTCTCTTTAGAGCAATTGAAAGAA GCAAACAAAGACGGTTTGGTAGATGTATTGCAAGGCGAATACAAC CTGTTAAACCGTGAAGCGGAAAAAACATTCTTCCCGTATACGAAG GAGCATAATATTTTCAATTTATCCCTTACTTCCCTCTCGTATCAGGTT TATTGGCAGGAAAGTATACAGAAGATACAACGTTCCCAGAAGGCG ACCTGCGAAACGAACAGGAACACTTCAAGGGTGAGCGTTTCAAA GAAAATATCAGAAAGGTCAACAAGCTTGCGCCGATTGCCGAAAA ACACAACGTGGATATCCCTCACATCGTATTGGCCTGGTATTTAGC AAGACCGGAAATTGATATTTTAATCCAGGAGCAAAACGTGCCGA TCAGCTGATTGATAACATCAAAACAGCTGACGTGACGCTTTCTCA AGAGGATATTTCAATTTATTGATAAGCTGTTTCGCATAA (序列号 9 8)

[0247] 【表1-50】

[0248]

yrpG / NP_390562.2 / <i>Bacillus subtilis</i> subsp. <i>subtilis</i> str. 168	
氨基酸 序列	MEYTYLGRTGLRVSRLCLGTMNFGVDTDEKTAFRIMDEALDNGI QFFDTANIYGWGNAGLTESIIGKWFAQGGQRREKVVLATKVYEP ISDPNDGPNDMRGLSLYKIRRHLEGLSLKRLQTDHIELYQMHHDR RTPWDEIWEAFETQVRSGKVDYIGSSNFAGWHLVKAQAEAEKRR FMGLVTEQHKYSLLETAEMEVLPAARDLGLGVVAWSPLAGLL GGKALKSNAGTRTAKRADLIEKHRLQLEKFSDLCKELGEKEANV ALAWVLANPVLTAPIIGPRTVEQLRDTIKAVEISLDKEILRMLNDIF PGPGGETPEAYAW (序列号 99)
碱基 序列	GTGGAGTATACCTATTTAGGGAGAACAGGATTGCGGGTGAGCCG TTTATGTTTAGGCACGATGAATTTTGGAGTTGATACAGACGAAAA GACTGCGTTCCGTATCATGGATGAAGCACTTGATAACGGCATTCA ATTTTTTGATACTGCCAATATTTACGGCTGGGGCAAAAACGCAGG ATTGACAGAGAGCATCATTGGAAAATGGTTTGCACAAGGAGGAC AGCGCCGCGAGAAAGTTGTTCTGGCGACAAAAGTATATGAACCG ATTTCTGATCCGAATGACGGACCAAATGATATGAGGGGCTTGCTCT CTATACAAAATCAGACGTCATCTGGAAGGATCACTGAAGCGGCTT CAGACAGATCATATCGAATTGTACCAAATGCATCATATCGATAGG CGGACACCGTGCGGATGAGATATGGGAAGCTTTTGAGACTCAGGT TCGCTCCGGCAAAGTAGACTATATTGGATCCAGTAATTTTGCAAGG CTGGCATTTAGTTAAAGCGCAAGCTGAAGCTGAAAAACGGCGATT CATGGGACTCGTCACTGAACAGCATAAGTATAGTTTATTAGAACG AACAGCTGAAATGGAAGTGCTGCCGGCTGCACGGGATCTTGTT TAGGAGTAGTGGCGTGGAGTCCCCTTGCAAGGAGGGCTTCTTGGC GGGAAGGCATTGAAAAGCAATGCCGGAACCTCGTACAGCAAAAAG AGCAGATTTAATTGAAAAACATCGTTTGCAACTCGAGAAATTTTC AGATTTATGCAAAGAACTAGGAGAAAAAGAAGCAAATGTGGCTTT GGCATGGGTGCTGGCAAATCCAGTTTAACTGCGCCGATCATCGG ACCACGAACGGTTGAGCAGCTGCGTGATACGATAAAAGCCGTTG AAATCAGTCTGGATAAGGAGATTCTCCGCATGTAAATGATATCT TTCCCGGACCTGGAGGAGAGACACCTGAGGCATACGCCTGGTGA (序列号 100)

[0249] 本发明中,可以降低1种ADH的活性,也可以降低2种以上的ADH活性。从进一步降低副产物醇体的生成的方面出发,优选降低2种以上的ADH活性。

[0250] 本发明中,“ADH非降低株”(或者也简称为“非降低株”)是指未进行ADH活性降低的改变的菌株。作为ADH非降低株,可以举出例如各微生物株的野生型菌株或模式菌株、包含通过育种得到的菌株的衍生菌株等,但限于此。在大肠杆菌菌株中,可以举出例如K-12株、B株、C株、W株、这些菌株的衍生菌株、例如BL21 (DE3) 株、W3110株、MG1655株、JM109株、DH5α株、HB101株等,但限于此。

[0251] 关于基因重组微生物,“按照醇脱氢酶的活性降低的方式进行了改变”至少是指,进行了编码醇脱氢酶的基因的表达被抑制的改变。“醇脱氢酶的活性降低的改变”中,除了编码醇脱氢酶的基因的表达被抑制的改变以外,还包括该酶的活性被抑制的改变。即,本发明的重组微生物按照相对于非降低株(例如宿主微生物)而言编码醇脱氢酶的基因的表达

被抑制、或者该酶的活性被抑制的方式进行了改变。更详细而言，“按照醇脱氢酶的活性降低的方式进行了改变”至少是指，进行了编码醇脱氢酶的基因的表达被抑制的改变，优选是指进行了编码醇脱氢酶的基因的表达被抑制、并且醇脱氢酶的活性被抑制的改变。由于宿主微生物可能具有多个编码醇脱氢酶的基因，针对同一底物存在多个显示出活性的醇脱氢酶，因此即便在“按照醇脱氢酶的活性降低的方式进行了改变”的情况下，与非降低株相比在醇种的分解活性方面有时也会维持醇脱氢酶的活性，所谓“进行了醇脱氢酶的活性降低的改变”还包括尽管如此进行了以降低活性为目的的改变但与非降低株相比仍维持了醇脱氢酶的活性的情况。本发明中，关于编码酶的基因，“表达的抑制”包括“表达的降低”。另外，关于酶，“活性的抑制”与“功能的抑制”、“功能的降低”和“活性的降低”含义相同，可互换使用。

[0252] 本发明的基因重组微生物优选进行了编码醇脱氢酶的基因中的2种以上的表达被抑制的改变。通过抑制两种以上的基因的表达，基因重组微生物能够在二胺化合物的制造中显著提高二胺化合物的生成量，同时能够抑制作为副产物的醇体的生成。

[0253] ADH的活性降低的改变例如可以通过降低编码ADH的基因的表达来实现。更具体而言，基因的表达降低可以指基因的转录量(mRNA量)降低和/或基因的翻译量(蛋白质质量)降低。基因的表达降低还包括基因完全不表达的情况。

[0254] 基因表达的降低例如可以为转录量的降低，可以为翻译量的降低，也可以为它们的组合。转录量的降低例如可以通过改变ADH基因的启动子区域或核糖体结合位点(RBS)等表达调节区域的方法来实现。基因的转录量的降低可以通过本领域技术人员公知的方法进行评价，可以举出例如定量RT-PCR法、Northern印迹法。基因的转录量例如与ADH非降低株相比可以降低到50%以下、20%以下、10%以下、5%以下、或0%。

[0255] 翻译量的降低例如可以举出通过在基因上游插入核糖开关区域来抑制翻译的方法。核糖开关是指与特定的低分子化合物选择性地结合的RNA，将该低分子化合物称为配体。在不存在配体的条件下利用RNA碱基对形成二次结构，对核糖开关周边的核酸产生影响。特别是，在核糖开关的下游包含核糖体结合位点的情况下，通过妨碍核糖体向核糖体结合位点接近，可妨碍位于更下游的基因的mRNA的翻译。另一方面，在配体存在下，通过与配体结合相伴的二次结构消除，核糖体能够向核糖体结合位点接近。因此，在不添加配体时，基因的mRNA不被翻译，靶基因的表达受到抑制。基因翻译量的降低可以通过本领域技术人员公知的方法来评价，可以举出例如蛋白印迹法。基因的翻译量例如与ADH非降低株相比可以降低到50%以下、20%以下、10%以下、5%以下、或0%。

[0256] 另外，ADH的活性降低的改变也可以通过破坏编码ADH的基因来实现。ADH基因的破坏是指按照具有ADH活性的蛋白质不表达的方式来改变基因，包括完全不产生蛋白质的情况、产生ADH活性降低或消失的蛋白质的情况。例如，可以通过使染色体上的基因的编码区的一部分或全部缺损来实现。进而，也可以包括染色体上的基因的前后的序列在内使基因整体缺失。只要能够实现ADH活性的降低，则缺失的区域可以为N端区域、内部区域、C端区域中的任一区域。

[0257] 另外，ADH基因的破坏也可以通过向染色体上的ADH基因的编码区引入氨基酸置换(错义突变)的方法、引入终止密码子(无义突变)的方法、或者引入附加或缺失1~2个碱基的移码突变来实现。

[0258] 进而,ADH基因的破坏也可以通过在染色体上的基因的编码区插入其他序列来实现。作为其他序列,可以举出抗生素抗性基因、转座子,只要降低ADH活性就没有特别限定。

[0259] ADH基因的破坏可以利用采用了同源重组的方法,可以举出例如使用了 λ -噬菌体的Red recombinae的方法(Datsenko,Kirill A.,and Barry L.Wanner.“One-step inactivation of chromosomal genes in *Escherichia coli* K-12 using PCR products.”*Proceedings of the National Academy of Sciences* 97.12(2000):6640-6645.);使用了包含温度敏感性复制起点的自杀载体的方法(Blomfield et al.,*Molecular microbiology* 5.6(1991):1447-1457.);使用了CRISPR-Cas9系统的方法(Jiang,Yu,et al.“Multigene editing in the *Escherichia coli* genome via the CRISPR-Cas9 system.”*Appl.Environ.Microbiol.*81.7(2015):2506-2514.)等,但不仅限于这些方法。

[0260] 另外,ADH基因的破坏可以通过突变处理来进行。作为突变处理,可以举出例如X射线处理、紫外线处理、 γ 射线处理等物理处理;利用N-甲基-N'-硝基-N-亚硝基胍、甲磺酸乙酯、甲磺酸甲酯等突变剂的化学处理,只要降低ADH活性就没有特别限定。

[0261] ADH活性可以通过本领域技术人员公知的方法进行评价。可以举出例如与底物(醛或酮)和NAD(P)H一起进行培养并测定340nm的吸光度,由此监视NAD(P)H的氧化的方法(Pick,et al.,*Applied microbiology and biotechnology* 97.13(2013):5815-5824.)。ADH活性例如与ADH非降低株的ADH相比可以降低到50%以下、20%以下、10%以下、5%以下、或0%。

[0262] 本发明的基因重组微生物中,参与二胺化合物合成的酶可以为内源性,可以为外源性,也可以为它们的组合。

[0263] 本发明的基因重组微生物优选表达羧酸还原酶作为参与二胺化合物合成的酶基因。一般而言,羧酸还原酶(Carboxylic Acid Reductase;CAR)是指具有还原羧酸并转换成醛的活性的任意的蛋白质。本发明中,羧酸还原酶例如具有将羧酸半醛、二羧酸、或者氨基酸的羧基转换成醛的活性。作为羧酸还原酶,可以举出例如分类为EC1.2.1.30、EC1.2.1.31、EC1.2.1.95、EC1.2.99.6等的酶,但不仅限于此。

[0264] 作为编码该酶的基因的来源的示例,只要具有羧酸还原活性就没有特别限定,作为典型的示例,可以举出艾阿华诺卡氏菌(*Nocardia iowensis*)、星形诺卡氏菌(*Nocardia asteroides*)、巴西诺卡氏菌(*Nocardia brasiliensis*)、鼻疽诺卡菌(*Nocardia farcinica*)、*Segniliparus rugosus*、*Segniliparus rotundus*、微代谢棒状杆菌(*Tsukamurella paurometabola*)、海洋分枝杆菌(*Mycobacterium marinum*)、新金色分枝杆菌(*Mycobacterium neoaurum*)、脓肿分枝杆菌(*Mycobacterium abscessus*)、鸟分枝杆菌(*Mycobacterium avium*)、龟分枝杆菌(*Mycobacterium chelonae*)、免疫分枝杆菌(*Mycobacterium immunogenum*)、耻垢分枝杆菌(*Mycobacterium smegmatis*)、干腐菌(*Serpula lacrymans*)、异担子菌(*Heterobasidion annosum*)、灰拟鬼伞(*Coprinopsis cinerea*)、黄曲霉(*Aspergillus flavus*)、土曲霉(*Aspergillus terreus*)、粗糙脉孢霉(*Neurospora crassa*)、酿酒酵母(*Saccharomyces cerevisiae*),但不仅限于此。本发明中,例如,使用编码由序列号101~104中的任一者中记载的氨基酸序列构成的蛋白质的基因。优选使用编码脓肿分枝杆菌(*Mycobacterium abscessus*)来源的羧酸还原酶MaCar的基因。

将MaCar基因的编码区的碱基序列示于序列号105,将MaCar的氨基酸序列示于序列号103。

[0265] 【表2-1】

登录号/来源 (蛋白质名)	氨基酸序列
AAR91681 / N o c a r d i a i o w e n s i s	MAVDSPDERLQRRIAQLFAEDEQVKAARPLEAVSAAVSAPGMRL AQIAATVMAGYADRPAAAGQRAFELNTDDATGRTSLRLLPRFETI TYRELWQRVGEVAAAHHDPENPLRAGDFVALLGFTSIDYATLD LADIHLGAVTVPLQASAAVSQLIAILTETSPRLLASTPEHLDAAVE CLLAGTTPERLVVFDYHPEDDDQRAAFESARRRLADAGSSVIVE TLDAVRARGRDLPAAPLFVPTDDDDPLALLIYTSGSTGTPKGAM YTNRLAATMWQGNSMLQGNSQRVGINLNYMPMSHIAGRISLFG VLARGGTAYFAAKSDMSTLFEDIGLVRPTEIFFVPRVCDMVFQRY QSELDRRSVAGADLDTLDREVKADLRQNYLGGRFLVAVVGSAPL AAEMKTFMESVLDLPLHDGYGSTEAGASVLLDNQIQRPVLDY KLVDVPELGYFRTPDRPHPRGELLKAETTIPGYKRPVTAEIFD EDGFYKTGDIVAELEHDLRVYVDRRNNVLKLSQGEFVTVAHLEA VFASSPLIRQIFIYGSSERSYLLAVIVPTDDALRGRDTATLKSALA ESIQRIAKDANLQPYEIPRDFLIETEPFTIANGLLSGIAKLLRPNL KERYGAQLEQMYTDLATGQADELLALRREAADLPVLETVSRAA KAMLGVASADMRPDHFTDLGGDSLSALSFSNLLHEIFGVEVPV GVVVSPANELRDLANYIEAERNNGAKRPTFTSVHGGGSEIRAAD LTLDKFIDARTLAAADSIPHAPVPAQTVLLTGANGYLGRFLCLE WLERLDKTGGTLICVVRGSDAAAARKRLDSAFDSGDPGLLEHY QQLAARTLEVLAGDIGDPNLGLDDATWQRLAETVDLIVHPAALV NHVLPYTQLFGPNVVGTAIEIVRLAITARRKPVTYLSTVGVADQV DPAEYQEDSDVREMSAVRVVRESYANGYGNSKWAGEVLLREAH DLCGLPVAVFRSDMILAHRSRYAGQLNVQDVFTRLILSLVATGIAP YSFYRTDADGNRQRAHYDGLPADFTAAAITALGIQATEGFRTYD VLNPYDDGISLDEFVDWLVESGHPIQRITDYSDWFHRFETAIRA LPEKQRQASVLPLLDAYRNPCEPAVRGAILPAKEFQAAVQTAKIGP EQDIPHLSAPLIDKYVSDLELLQLL (序列号 1 0 1)
ACC40567 / M y c o b a c t e r i u m m a r i n u m	MSPITREERLERRIQDLYANDPQFAAAKPATAITAAIERPGLPLPQ IIETVMTGYADRPALAQRSVEFVTDAGTGHTTLRLLPHFETISYG ELWDRISALADVLSREQTVKPGDRVCLLGFNVDYATIDMTLAR LGAVAVPLQTSAAITQLQPIVAETQPTMIAASVDALADATELALS GQTATRVLVFDHHRQVDAAHRAAVESARERLAGSAVVETLAEIA RGDVPRGASAGSAPGTDVSDDSLALLIYTSGSTGAPKGAMYPRR

[0266]

[0267]

	NVATFWRKRTWFEGGYEPSITLNFMPMSHVMGRQILYGTLCNG GTAYFVAKSDLSTLFEDLALVRPTELTFVPRVWDMVFDEFQSEV DRRLVDGADRVALEAQVKAERNDVLGGRYTSALTGSAPISDEM KAWVEELLDMHLVEGYGSTEAGMILIDGAIRRPVLDYKLVDVP DLGYFLTDRPHPRGELLVKTDLSLFPGYQRAEVTADVFDADGFY RTGDIMAEVGPEQFVYLDRRNNVLKLSQGEFVTVSKLEAVFGDS PLVRQIYIYGNSARAYLLAVIVPTQEALDAVPVEELKARLGDSLQ EVAKAAGLQSYEIPRDFIETTPWTLENGLLTGIRKLARPQLKKH YGELLEQIYTDLAHGQADELRSLRQSGADAPVLVTVCRAAAALL GGSASDVQPDHFTDLGGDSLSALSFTNLLHEIFDIEVPVGVIVS PANDLQALADYVEAARKPGSSRPTFASVHGASNGQVTEVHAGD LSLDKFIDAATLAEAPRLPAANTQVRTVLLTGATGFLGRYLALE WLERMDLVDGKLICLVRAKSDTEARARLDKTFDSGDPELLAHY RALAGDHLEVLAGDKGEADLGLDRQTWQRLADTVDLIVDPAAL VNHVLPYSQLFGPNALGTAELLRLALTSKIKPYSYTSTIGVADQI PPSAFTEDADIRVISATRAVDDSYANGYSNSKWAGEVLLREAH LCGLPVAVFRCDMILADTTWAGQLNVPDMFTRMILSLAATGIAP GSFYELAADGARQRAHYDGLPVEFIAEAISTLGAQSQDGFHTYH VMNPYDDGIGLDEFVDWLNESGCPQRIADYGDWLQRFETALR ALPDRQRHSSLLPLLHNYRQPERPVRGSIAPTDRFRAAVQEAKI GPDKDIPHVGAPIIVKYVSDLRLLGLL (序列号 102)
CAM64782 / Mycobacterium abscessus (MaCar)	MTETISTAAPTTDLEEQVKRRIEQVVSNDPQLAALLPEDSVTEA VNEPDLPLVEVIRRLLEGYGDRPALGQRAFEFVTGDDGATVIAL KPEYTTVSYRELWERAEIAAAWHEQGIRDGDFVAQLGFTSTDF ASLDVAGLRLGTVSVPLQTGASLQQRNAILEETRPVAFASIEYL DAAVDSVLATPSVRLLSVFDYHAEVDSQREALEAVRARLESAGR TIVVEALAEALARGRDLPAAPLPSADPDALRLLIYTSGSTGTPKG AMYPQWLVANLWQKKWLTDDVIPSIGVNFMPMSHLAAGRLTLMG TLSGGGTAYYIASSDLSTFFEDIALIRPSEVLVPRVEMVVFQRF QAELDRSLAPGESNSEIAERIKVRIREQDFGGRVLSAGSGSAPLS PEMTEFMESLLQVPLRDGYGSTEAGGVWRDGVLRPPVTDYKL VDVPELGYFTTDSPPHPRGELRLKSETMFPGYKRPETTADVFD EGYYKTGDVVAELGPDHLKYLDVKNVLKLAQGEFVAVSKLEA AYTGSPLVRQIFVYGNSESRFLLAVVVPTPEVLERYADSPDALKP LIQDSLQQVAKDAELQSYEIPRDFIVETVPFTVESGLLSDARKLL RPKLKDHYGERLEALYAELAESQNERLRQLAREAAATRPVLETVT DAAAALLGASSDLAPDVRFIDLGGDSLSALSSELLRDIFEVDV PVGVINSVANDLAAIARHIEAQRTGAATQPTFASVHGKDATVITA

[0268]

	GELTLDKFLDESLLKAAKDVQPATADVKTVLVTGGNGWLGRWL VLDWLERLAPNGGKVYALIRGADAEAAARARLDAVYESGDPKLSA HYRQLAQQSLEVIAGDFGDQDLGLSQEVWQKLAKDVDLIVHSG ALVNHVLPYSQLFQPNVAGTAEIHKLAISERLKPVTYLSTVGIAD QIPVTEFEEDSDVRVMSAERQINDGYANGYGNKSWAGEVLLRE AHDLAGLPVRVFRSDMILAHSDYHGQLNVTDFVTRSIQSLLLGTG VAPASFYELDADGNRQRAHYDGVPGDFTAASITAIGGVNVVDGY RSFDVFNPHHDGVSMDFVDWLIDAGYKIARIDDDYDQWLARFE LALKGLPEQQRQQSVLPLLKMYEKPQPAIDGSALPTAEFSRAVH EAKVGDSGEIPHVTKEILILKYASDIQLLGLV (序列号 1 0 3)
AFP42026 / M y c o b a c t e r i u m s m e g m a t i s	MHQLTVTGMNICEVQRLFPRMTSDVHDATDGVTTETALDDEQST RRIAELYATDPEFAAAAPLPAVVDAAHKPGRLRLAEILQTLFTGYG DRPALGYRARELATDEGGRTVTRLLPRFDTLTYAQVWSRVQAVA AALRHNFAQPIYPGDAVATIGFASPDYLTLDLVCAYLGLVSVPLQ HNAFVSRLAPILAEVEPRILTVSAEYLDLAVESVRDVNSVSQLVV FDHHPEVDDHRDALARAREQLAGKGIAVTTLDIAIDEGAGLP AE PIYTADHDQRLAMILYTSGSTGAPKGAMYTEAMVARLWTMSFIT GDPTPVINVNFMPLNHLGGRIPISTAVQNGGTSYFVPESDMSTL FEDLALVRPTELGLVPRVADMLYQHHLATVDRLVTQGADeltaE KQAGAEELREQVLGGRVITGFVSTAPLAAEMRAFLDITLGAHIVD GYGLTETGAVTRDGVIVRPPVIDYKLIDVPELGYFSTDKPYPRGE LLVRSQTLTPGYKRPVETASVFDRDGYHTGDVMAETAPDHLV YVDRRNNVLKLAQGEFVAVANLEAVFSGAALVRQIFVYGNSESR FLLAVVVPTPEALEQYDPAALKAALADSLQRTARDAELQSYEVP ADFIVETEPFSAANGLLSGVGKLLRPNLKD RYQGRLEQMYADIA ATQANQLRELRRAAATQPVIDTLTQAAATILGTGSEVASDAHFTD LGGDSLSALTLSNLLSDFFGFEVPVGTIVNPNATNLAQLAQHIEAQ RTAGDRRPSFTTVHGADATEIRASELTLDKFIDAETLRAAPGLPK VTTEPRTVLLSGANGWLGRFLTLQWLERLAPVGGTLITIVRGRD DAAARARLTQAYDTPELSRRAELADRHLRVVAGDIGDPNLGL TPEIWHRLAAEVDLVVHPAALVNHVLPYRQLFGPNVVGTAEVK LALTERIKPVTYLSTVSVAMGIPDFEEDGDIRTVSPVRPLDGGYA NGYGNKSWAGEVLLREAHDLCLPVPATFRSDMILAHPRYRGQV NVPDMFTRLLLSLLITGVAPRSFYIGDGERPRAHYPGLTVDFVAE AVTTLGAQQREGYVSVDVMNPHDDGISLDVFDWLIRAGHPIDR VDDYDDWVRRFETALTALPEKRRRAQTVLPLLHAFRAPQAPLRG APEPTEVFHAAVRTAKVGP GDIPHLDEALIDKYIRDLREFGLI (序列号 1 0 4)

[0269] 【表2-2】

[0270]

MaCar 的编码区的碱基序列

ATGACTGAAACGATCTCCACAGCGGCTGTCCCCACTACGGATCTCGAAGAG
CAGGTGAAGCGACGCATCGAGCAGGTCGTGTCCAACGATCCGCAGCTGGC
GGCGCTTCTCCCGGAAGATTCGGTCACCGAGGCGGTCAACGAGCCCGATCT
ACCGCTGGTCGAGGTGATCAGGCGACTGCTGGAGGGCTACGGTGACCGCC
CGGCACTCGGCCAGCGCGCCTTCGAGTTCGTACCCGGGACGACGGTGCG
ACCGTGATCGCGCTGAAGCCCGAATACACCACCGTCTCCTACCGCGAGTTG
TGGGAACGTGCCGAGGCTATCGCTGCCGCGTGGCACGAGCAGGGCATCCG
TGACGGCGACTTCGTCTGCTCAGTTGGGTTTCACCAGCACGGACTTCGCGTC
GCTCGACGTCTCGGGGATTGCGTCTGGGCACCGTCTCGGTGCCCTGCAGAC
GGGCGCGTCTGCTGCAGCAGCGCAACGCGATTCTCGAAGAGACCCGGCCCG
CAGTCTTTGCCGCGAGTATCGAATACCTTGATGCCGCCGTCTGATTCCGGTGC
TTGCGACCCCTCGGTGCGACTCCTCTCGGTTTTTCGACTATCACGCGGAGG
TCGACAGCCAGCGCGAAGCGCTGGAGGCTGTGCGGGCCCGGCTTGAGAGT
GCCGGCCGGACGATCGTCGTCTGAGGCCCTGGCGGAGGCTCTCGCGCGGGG
GCGGGACCTGCCCGCCGCGCCGCTGCCCAGTGCAGATCCCGATGCCTTGCG
TCTGCTCATCTACACCTCCGGCAGCACCGGTACCCCCAAGGGCGCCATGTA
TCCGCAATGGCTGGTCGCCAACTTGTGGCAGAAGAAGTGGCTCACCGACGA
TGTGATTCCGTCCATAGGCGTGAAC TTCATGCCCATGAGCCACCTGGCGGG
TCGCCTCACTCTCATGGGCACCCTTTCGGGTGGCGGAACCGCCTACTACAT
CGCTTCGAGCGATCTTTCTGACTTTCTTCGAGGACATCGCGCTCATCCGCCC
CTCCGAAGTGCTCTTCGTGCCGCGTGTGGTGGAGATGGTGTTCCAGCGTTT
TCAGGCAGAATTGGACCGGTCCCTTGCCCCGGGTGAGAGCAACTCCGAGAT
CGCGGAGCGAATCAAGGTCCGCATCCGGGAACAGGACTTCGGCGGGGCGTG
TGCTCAGTGCTGGCTCCGGGTCCGGCCCCGTTGTCTCCTGAGATGACGGAGT
TCATGGAGTCGCTGCTGCAGGTGCCGTTGCGCGACGGGTATGGGTCCACCG
AGGCCGGTGGTGTGTGGCGTGACGGAGTCCTGCAGCGTCCGCCCCGTCACC
GACTACAAGCTGGTTGACGTTCCGGAACTCGGATACTTCACCACAGATTCG
CCGCATCCCCGTGGCGAGCTGCGGTTGAAGTCGGAGACGATGTTCCCCGGC
TACTACAAGCGCCCGGAGACCACTGCCGATGTCTTCGATGACGAGGGGTAC
TACAAGACCGGTGACGTGGTCGCCGAGCTCGGGCCGGATCACCTCAAGTAC
CTCGACCGCGTCAAGAACGTCCTCAAGCTCGCGCAGGGAGAGTTTGTCGCG
GTGTCAAAGCTGGAGGCCGCTTACACCGGCAGCCCGCTGGTCCGGCAGATC
TTTGTGTACGGGAACAGTGAACGCTCGTTCTGCTGGCTGTCGTGGTCCCG
ACACCCGAAGTCCTTGAGCGGTACGCAGATTCCGCCAGATGCGCTCAAGCCC
TTGATCCAGGATTCGCTGCAGCAGGTCGCCAAGGACGCGGAGCTGCAATCC
TATGAGATACCGCGCGACTTCATCGTTGAGACGGTGCCGTTACCGTCGAG

[0271]

TCCGGATTGCTATCGGACGCGCGAAAGCTGCTGCGCCCCAAGCTGAAGGAT
CACTACGGAGAGAGGCTGGAGGCGCTGTACGCCGAAGTGGCGGAAAGCCA
GAATGAGCGGCTGCGCCAGTTGGCCAGGGAGGCAGCCACGCGCCCGGTCC
TGGAGACGGTGACCGATGCGGCCGCGCGCTGCTGGGCGCATCGTCCTCG
GATCTGGCTCCTGATGTGCGATTTCATCGACCTCGGTGGCGACTCACTGTCTG
GCGCTGTCTACTCCGAGCTGCTGCGCGACATCTTTGAGGTGGACGTTCCG
GTGGGCGTCATCAACAGCGTCGCCAACGACCTTGCCGCGATCGCCCGGCAC
ATCGAGGCGCAGCGGACCGGCGCCGCTACGCAGCCGACCTTTGCGTCCGT
CCACGGCAAGGACGCGACGGTCATCACCGCCGGTGAAGTCAACCTCGACAA
GTTCTTGAGACGAGTCACTGTTGAAAGCGGCCAAGGACGTTTCAGCCGGCAAC
GGCCGATGTCAAGACCGTTCTAGTGACCGGCGGCAACGGCTGGTTGGGTCTG
TTGGCTGGTGCTCGATTGGCTGGAGCGGTTGGCACCCAATGGTGGCAAGGT
CTACGCCCTCATTCGTGGCGCCGATGCCGAAGCAGCCCGGGCACGGTTGGA
CGCCGTGTACGAATCGGGTGATCCCAAGCTGTCCGCGCATTATCGTCAGCT
GGCGCAACAGAGTCTGGAAGTTATCGCCGGCGATTTTCGGCGACCAGGATCT
CGGTCTATCCCAGGAAGTTTGGCAGAAGCTGGCCAAGGACGTGGACCTGAT
CGTGCACTCCGGTGCTTGGTGAACCACGTGCTGCCGTACAGCCAGTTGTT
CGGTCCGAATGTGGCGGGTACCGCCGAGATCATCAAGCTGGCAATTTCCGA
GCGGCTCAAGCCGGTCACCTACCTGTCGACGGTGGGCATCGCCGACCAGAT
TCCGGTGACGGAGTTCGAGGAAGACTCCGATGTTTCGTGTGATGTCCGCCGA
GCGCCAGATCAATGACGGCTACGCGAACGGATACGGCAACTCAAAATGGGC
CGGCGAGGTGCTGTTGCGGGAGGCTCATGACCTAGCGGGGCTGCCGGTG
GTGTGTTCCGCTCCGACATGATCCTGGCGCACAGTGAAGTACCACGGACAGC
TCAACGTCACCGACGTGTTACCCGGAGCATCCAGAGTCTGCTGCTCACCG
GTGTTGCACCGGCCAGCTTCTATGAATTGGATGCCGACGGCAATCGGCAGC
GCGCTCACTATGACGGTGTGCCCGGCGATTTACCGCCGCATCGATCACCG
CCATCGGCGGTGTGAACGTGGTAGACGGTTACCGCAGCTTCGACGTGTTCA
ACCGCACCATGACGGTGTCTCGATGGATACCTTCGTCGACTGGCTGATCG
ACGCAGGCTACAAGATCGCGCGGATCGACGATTACGACCAGTGGCTCGCCC
GGTTTCGAGCTGGCCCTCAAGGGATTGCCCGAGCAGCAGCGGCAACAGTCG
GTGTTGCCACTTCTCAAGATGTACGAGAAGCCGCAACCGGCGATCGACGGA
AGTGCACTTCGACCGCAGAATTCAGTCGCGCCGTGCACGAGGCGAAGGTC
GGAGACAGCGGTGAGATACCGCACGTACCAAGGAGCTGATCCTCAAGTAC
GCCAGCGATATTCAGCTGTTGGGCCTGGTGTAG (序列号 105)

[0272] 羧酸还原酶的活性可以通过本领域技术人员公知的方法进行评价,可以举出例如:在ATP和NADPH的存在下培养底物(羧酸)和酶并测定340nm的吸光度,由此监视NADPH的氧化的方法;对底物的消耗量和/或生成物(醛)的生成量进行定量的方法(Venkitasubramanian et al., Journal of Biological Chemistry, Vol.282, No.1, 478-485 (2007))。

[0273] 另外,羧酸还原酶可以通过磷酸泛酰巯基乙胺基化而转换成活性型的全酶(Venkitasubramanian et al., Journal of Biological Chemistry, Vol.282, No.1, 478-485 (2007))。磷酸泛酰巯基乙胺基化被磷酸泛酰巯基乙胺基转移酶(Phosphopantetheinyl Transferase; PT)催化(可以举出例如分类为EC2.7.8.7的酶等)。因此,本发明的微生物可

以进一步按照磷酸泛酰巯基乙胺基转移酶的活性增大的方式进行改变。作为增大磷酸泛酰巯基乙胺基转移酶的活性的方法,可以举出引入外来的磷酸泛酰巯基乙胺基转移酶基因的方法、增强内源性的磷酸泛酰巯基乙胺基转移酶基因的表达的方法,但不限于于此。作为磷酸泛酰巯基乙胺基的供体,可以举出辅酶A (CoA)。

[0274] 作为PT基因的来源,只要具有磷酸泛酰巯基乙胺基转移活性就没有特别限定,作为编码典型的磷酸泛酰巯基乙胺基转移酶的基因,可以举出例如枯草杆菌 (*Bacillus subtilis*) 的Sfp、艾阿华诺卡氏菌 (*Nocardia iowensis*) 的Npt (Venkitasubramanian et al., Journal of Biological Chemistry, Vol.282, No.1, 478-485 (2007))、酿酒酵母 (*Saccharomyces cerevisiae*) 的Lys5 (Ehmann et al., Biochemistry 38.19 (1999): 6171-6177.)。本发明中,例如,使用编码由序列号106~108中的任一者中记载的氨基酸序列构成的蛋白质的基因。优选使用艾阿华诺卡氏菌 (*Nocardia iowensis*) 来源的艾阿华诺卡氏菌 (*Nocardia iowensis*) 的Npt基因。将Npt基因的编码区的碱基序列示于序列号109,将Npt的氨基酸序列示于序列号107。

[0275] 【表3-1】

[0276]

登录号 / 来源 (蛋白质名)	氨基酸序列
CAA41858 / B a c i l l u s s u b t i l i s 来源 (S f p)	MKIYGIYMDRPLSQEENERFMTFISPEKREKCRRFYHKEDAHRT LLGDVLVRSVISRQYQLDKSDIRFSTQEYGKPCIPDLPAHFNISH SGRWVIGAFDSQPIGIDIEKTKPISLEIAKRFFSKTEYSDLLAKDK DEQTDYFYHLWSMKESFIKQEGKGLSLPLDSFSVRLHQDGQVSI ELPDSHSPCYIKTYEVDPGYKMAVCAAHPDFPEDITMVSYEELL (序列号 106)
ABI83656 / N o c a r d i a i o w e n s i s 来源 (N p t)	MIETILPAGVESAELEYPEDLKAHPAEEHIAKSVEKRRRDFIGA RHCARLALAE LGEPVVAIGKGERGAPIWPRGVVGS LTHCDGYRAA AVAHKMRFRSIGIDAEPHATLPEGVLDSVSLPPEREWLKT TDSAL HLDRL LFCAKEATYKAWWPLTARWLGFEAAHITFEIEDGSADSG NGTFHSELLVPGQTNDGGTPLL SFDGRWLIADGFILTAIAYA (序列 号 107)
CAA96866 / S a c c h a r o m y c e s c e r e v i s i a e 来源 (L y s 5)	MVKTTEVVSEVSKVAGVRPWAGIFVVEIQEDILADEFTFEALMRT LPLASQARILNKKSFHDRCSNLCSQLLQLFGCSIVTGLNFQELKF DKGSFGKPFLDNNRFLPFSMTIGE QYVAMFLVKCVSTDEYQDVGI DIASPCNYGGREELELFKEVFSEREFNGLLKASDPCTIFTYLWSL KESYTKFTGTGLNTDLSLIDFGAISFFPAEGASMCITLDEVPLIFH SQWFNNEIVTICMPKSISDKINTNRPKLYNISLSTLIDYFIENDGL (序列号 108)

[0277] 【表3-2】

[0278]

N p t 的编码区的碱基序列

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ATGATCGAGACAATTTTGCTGCTGGTGTCTGAGTCGGCTGAGCTGCTGGAG
TATCCGGAGGACCTGAAGGCGCATCCGGCGGAGGAGCATCTCATCGCGAAG
TCGGTGGAGAAGCGGCGCCGGGACTTCATCGGGGCCAGGCATTGTGCCCCG
GCTGGCGCTGGCTGAGCTCGGCGAGCCGCGGTGGCGATCGGCAAAGGGG
AGCGGGGTGCGCCGATCTGGCCGCGCGGCGTCGTCGGCAGCCTCACCCAT
TGCGACGGATATCGGGCCGCGGCGGTGGCGCACAAAGATGCGCTTCCGTTTCG
ATCGGCATCGATGCCGAGCCGACGCGACGCTGCCCGAAGGCGTGCTGGAT
TCGGTCAGCCTGCCGCCGAGCGGGAGTGTTGAAGACCACCGATTCCGC
ACTGCACCTGGACCGTTTACTGTTCTGCGCCAAGGAAGCCACCTACAAGGC
GTGGTGGCCGCTGACCGCGCGCTGGCTCGGCTTCGAGGAAGCGCACATCA
CCTTCGAGATCGAAGACGGCTCCGCCGATTCCGGCAACGGCACCTTTCACA
GCGAGCTGCTGGTGCCGGGACAGACGAATGACGGTGGGACGCCGCTGCTT
TCGTTTCGACGGCCGGTGGCTGATCGCCGACGGGTTTCATCCTCACCGCGATC
GCGTACGCCTGA ( 序列号 109 )

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[0279] 作为生成醛的其他方式,本发明的基因重组微生物可以表达酰基-(酰基载体蛋白(ACP))还原酶(AAR)。AAR是承担由酰基ACP向醛的转换的酶。编码AAR的基因没有特别限定,作为典型的AAR基因,可以举出例如细长聚球藻(*Synechococcus elongatus*)的AAR(Schirmer, Andreas, et al., Science 329.5991 (2010):559-562.)等。

[0280] 另外,作为其他方式,可以表达由酰基CoA生产醛的酶。作为编码催化本反应的酶的基因,可以举出例如编码脂肪酸酰基-CoA脱氢酶的贝氏不动杆菌(*Acinetobacter baylyi*)的acr1(ZHENG, Yan-Ning, et al., Microbial cell factories, 2012, 11.1:65.)、编码克氏梭菌(*Clostridium kluyveri*)的琥珀酸半醛脱氢酶的sucD基因(Sohling, B., and Gerhard Gottschalk., Journal of bacteriology 178.3 (1996):871-880.),但不限于于此。

[0281] 此外,可以表达由酰基磷酸生成醛的酶,例如催化由NADPH依赖性的4-天冬氨酰磷酸生成天冬氨酸半醛的反应的天冬氨酸半醛脱氢酶(ASD; EC1.2.1.11)会催化同样的反应,可以利用大肠杆菌的asd基因等。

[0282] 本发明的基因重组微生物表达转氨酶作为参与二胺化合物合成的酶基因。

[0283] 转氨酶是指在氨基供体和受体的存在下催化转氨反应的任意的酶。作为转氨酶,例如,可以举出分类为EC2.6.1.p(此处,p为1以上的整数)的酶。作为氨基供体,可以举出L-谷氨酸、L-丙氨酸、甘氨酸,但不限于于此。

[0284] 作为编码转氨酶的基因,只要具有转氨活性就没有特别限定,可以适宜地利用腐胺转氨酶或其他二胺转移酶。例如,可以举出编码大肠杆菌的腐胺转氨酶(已报道了其对尸胺或亚精胺进行转氨)的ygjG基因(Samsonova., et al., BMC microbiology 3.1 (2003):2.)、编码假单胞菌属的腐胺转氨酶的SpuC基因(Lu et al., Journal of bacteriology 184.14 (2002):3765-3773.、Galman et al., Green Chemistry 19.2 (2017):361-366.)、编码大肠杆菌的GABA转氨酶的gabT基因、puuE基因等。此外,据报道玫瑰杆菌(*Ruegeria pomeroyi*)、紫色杆菌(*Chromobacterium violaceum*)、烟草节杆菌(*Arthrobacter citreus*)、嗜热球形杆菌(*Sphaerobacter thermophilus*)、费希尔曲霉(*Aspergillus*

fischeri)、河流弧菌(*Vibrio fluvialis*)、根癌农杆菌(*Agrobacterium tumefaciens*)、百脉根中间根瘤菌(*Mesorhizobium loti*)等来源的 ω -转氨酶也具有向1,8-二氨基辛烷、1,10-二氨基癸烷等二胺化合物的转氨活性,可以适宜地利用(Sung et al., Green Chemistry 20.20(2018):4591-4595.、Sattler et al., Angewandte Chemie 124.36(2012):9290-9293.)。

[0285] 作为编码转氨酶的基因,本发明中,例如使用编码由序列号110~114中的任一者中记载的氨基酸序列构成的蛋白质的基因。优选使用大肠杆菌来源的腐胺转氨酶ygjG基因。将ygjG基因的编码区的碱基序列示于序列号115,将ygjG的氨基酸序列示于序列号110。

[0286] 【表4-1】

登录号 / 来源 (蛋白质名)	氨基酸序列
BAE77123 / E s c h e r i c h i a c o l i K - 1 2 来源 (y g j G)	MIREPPEHILNRLPSSASALACSAHALNLIKRTLDHEEMKALN REVIEYFKEHVNPGFLEYRKSVTAGGDYGAVEWQAGSLNTLVD TQQQEFIDCLGGFGIFNVGHRNPVVVSAVQNQLAKQPLHSQELL DPLRAMLAKTLAALTPGKCLKYSFFCNSGTESVEAALKLAKAYQS PRGKFTFIATSGAFHGKSLGALSATAKSTFRKPFMPLLPGRHV PFGNIEAMRTALNECKKTGDDVAAVILEPIQEGGGVILPPPGYLT AVRKLCDEFGALMILDEVQTMGRTGKMFACHEHENVQPDILCL AKALGGGVMPIGATIAATEEVFSVLFDNPFLHTTTTFGGNPLACAA ALATINVLLLEQNLPAAQAEQKGDMLLDGFRQLAREYPDVLVQEAR GKGMLMAIEFVDNEIGYNFASEMFRQRLVAGTLNNAKTIRIEP PLTLTIEQCELVKAARKALAAMRVSVEEA (序列号 1 1 0)
AAG03688 / P s e u d o m o n a s a e r u g i n o s a P A O 1 来源	MNSQITNAKTREWQALSRDHHLPPFTDYKQLNEKGARIITKAE GVYIWDSEGNKILDAMAGLWCNVVGYGREELVQAATRQMRELP FYNLFFQTAHPPVVELAKAIADVAPEGMNHVFFTGSGSEANDTV LRMVRHYWATKGQPQKKVVIGRWNGYHGSTVAGVSLGGMKAL HEQGDFPIPGIVHIAQPYWYGEAGDMSPDEFGVWAAEQLEKKI LEVGEENVAAFIAEPIQGAGGVIVPPDTYWPKIREILAKYDILFIA DEVICGFGRGTGEWFGSQYYGNAPDLMPIAKGLTSGYIPMGGVV VRDEIVEVLNQGGEFYHGFYSGHPVAAVALENIRILREEKIIE KVKAETAPYLQKRWQELADHPLVGEARGVGMVAALELVKNKKT RERFTDKGVGMLCREHCFRNLIMRAVGDTMIISPPLVIDPSQID ELITLARKCLDQTAAAVLA (序列号 1 1 1)

[0287]

[0288]

BAA16525 / E s c h e r i c h i a c o l i K - 1 2 来源 (g a b T)	MNSNKELMQRRSQAIPRGVGGIHPHIFADRAENCRVWDVEGREY LDFAGGIAVLNTGHLHPKVVAAVEAQLKKLSHTCFQVLAYEPYL ELCEIMNQKVPBGDFAKKTLLVTTGSEAVENAVKIARAATKRSGTI AFSGAYHGRTHYTLALTGKVNYPYSAGMGLMPGHVYRALYPCPL HGI SEDDAIASIHRIFKNDAA PEDIAAIVIEPVQGE GGFYASSPAF MQRLRALCDEHGI MLI ADEVQSGAGRTGT L FAMEQMGVAPDLT TFAKSIAGGFPLAGVTGRAEVMDAVAPGG LGGTYAGNPIACVAA LEV LKVFEQENLLQKANDLGQKLKDGLLAIAEKHPEIGDVRGL GAMIAIELFEDGDHNKPD AKLTAEIVARARDKGLILLSCGPYYN VLRILVPLTIEDAQIRQGLEIISQCFDEAKQ (序列号 1 1 2)
BAA14871 / E s c h e r i c h i a c o l i K - 1 2 来源 (p u u E)	MSNNEFHQRRLSATPRGVGVMCNFFAQSAENATLKDVEGNEYI DFAAGIAVLNTGHRHPDLVAAVEQQLQQFTHTAYQIVPYESYVTL AEKINALAPVSGQAKTAFFTTGAEAVENAVKIARAHTGRPGVIAF SGGFHGRTYMTMALTGKVAPYKIGFGPFPGSVYHVPYPSDLHGI STQDSLDAIERLFLKSDIEAKQVAII FEPVQGE GGFNVAPKELVA AIRRLCDEHGIVMIADEVQSGFARTGKLFAMDHYADKPDLM TM AKSLAGGMPLSGVVGNANIMDAPAPGG LGGTYAGNPLAVAAA H AVLNIIDKESLCERANQLGQRLKNTLIDAKESVPAIAAVRGLGSM IAVEFNDPQTGEPSAAIAQKIQRALAQGLLLLTCGAYGNVIRFL YPLTIPDAQFDAAMKILQDALSD (序列号 1 1 3)
WP_011049 154 / R u e g e r i a p o m e r o y i 来源	MATITNHMPTAELQALDAAHHLHPFSANNALGEEGTRVITRAR GVWLNDSEGE EILDAMAGLWCVNIGYGRDELA EVAARQMRELP YYNTFFKTTHVPAIALAQKLAELAPGDLNHVFFAGGGSEANDTN IRMVRTYWQNKGGQPEKTVIISRKNAYHGSTVASSALGGMAGMH AQSG LIPDVHHINQPNWWAEGGDM DPEEFGLARARELEEAILE LGENRVA AFIAEPVQGAGGVIVAPDSYWPEIQRICDKYDILLIAD EVICGFGRTGNWFGTQTMGIRPHIMTIAKGLSSGYAPIGGSIVCD EVAHVIGKDEFNHGYTYSGHPVAAA VALENLRILEEENILDHVR NVAAPYLKEKWEALTDHPLVGEAKIVGMMASIALTPNKASRAKF ASEPGTIGYICRERC FANNLIMRHVGDRMIISPPLVITPAEIDEMF VRIRKSLDEAQAEIEKQGLMKSA A (序列号 1 1 4)

[0289] 【表4-2】

[0290]

y g j G 的编码区的碱基序列

ATGATACGCGAGCCTCCGGAGCATATTTTGAACAGGTTACCTTCGAGCGCAT
 CGGCTTTAGCGTGCAGCGCCACGCCCTGAATCTCATTGAGAAGCGAACGC
 TGGATCATGAGGAGATGAAAGCACTTAACCGAGAGGTGATTGAATACTTCA
 AAGAGCATGTCAATCCGGGGTTTTTAGAGTATCGCAAATCTGTTACCGCCG
 GCGGGGATTACGGAGCCGTAGAGTGGCAAGCGGGAAGTTTAAATACGCTTG
 TCGACACCCAGGGCCAGGAGTTTATCGACTGCCTGGGAGGTTTTTGAATTT
 TCAACGTGGGGCACCGTAATCCAGTTGTGGTTTTCCGCCGTACAGAATCAAC
 TTGCGAAACAACCGCTGCACAGCCAGGAGCTGCTCGATCCGTTACGGGCGA
 TGTTGGCGAAAACCTTGCTGCGCTAACGCCCGGTAAACTGAAATACAGCT
 TCTTCTGTAATAGCGGCACCGAGTCCGTTGAAGCAGCGCTGAAGCTGGCGA
 AAGCTTACCAGTCAACGCGCGGCAAGTTTACTTTTATTGCCACCAGCGGCG
 CGTTCCACGGTAAATCACTTGGCGCGCTGTGCGGCCACGGCGAAATCGACCT
 TCCGCAAACCGTTTATGCCGTTACTGCCGGGCTTCCGTCATGTGCCGTTTG
 GCAATATCGAAGCCATGCGCACGGCTCTTAACGAGTGCAAAAAACCGGTG
 ATGATGTGGCTGCGGTGATCCTCGAACCATTGAGGTTGAAGGTGGCGTAA
 TTCTGCCGCCGCCGGGCTATCTCACCGCCGTACGTAAGCTATGCGATGAGT
 TCGGCGCACTGATGATCCTCGATGAAGTACAAACGGGCATGGGGCGCACGG
 GCAAGATGTTTCGCTGCGAGCATGAGAACGTACAGCCGGATATCCTCTGCC
 TTGCCAAAGCGCTCGGCGGCGGCGTGATGCCGATTGGCGCGACCATCGCCA
 CTGAAGAGGTGTTTTTCAGTTCTGTTTCGACAACCCATTCTCTGCATACCACCAC
 CTTTGGCGGCAACCCGCTGGCCTGTGCGGCGGCGCTGGCGACCATCAATGT
 GTTGCTGGAGCAGAACTTACCGGCTCAGGCTGAGCAAAAAGGCGATATGTT
 GCTGGACGGTTTCCGTCAACTGGCGCGGGAATATCCCGATCTGGTACAGGA
 AGCGCGTGGTAAAGGGATGTTGATGGCGATTGAGTTTGTGATAACGAAAT
 CGGCTATAACTTTGCCAGCGAGATGTTCCGCCAGCGCGTACTGGTGGCCGG
 AACGCTCAATAACGCCAAAACGATCCGCATTGAACCGCCACTGACACTGAC
 CATTGAACAGTGTGAACTGGTGATCAAAGCGGCGCGTAAGGCGCTGGCGGC
 CATGCGAGTAAGTGTCGAAGAAGCGTAA (序列号 115)

[0291] 能够用于本发明的编码上述酶的基因也可以来自所示例的生物以外,或者还可以人工合成,只要能够在宿主微生物细胞内表达实质性的酶活性即可。

[0292] 另外,能够用于本发明的目的的上述酶基因只要能够在上述宿主微生物细胞内表达实质性的酶活性,则可以具有能够在自然界产生的所有突变、人工引入的突变和修饰。例如,已知在编码特定氨基酸的各种密码子中存在多余的密码子。因此,本发明中也可以利用最终翻译成同一氨基酸的替代密码子。即,由于基因编码简并,因此可以使用多个密码子来编码某一特定的氨基酸,因此氨基酸序列可以由任意一组类似的DNA寡核苷酸编码。该组中只有一个成员与天然型酶的基因序列相同,但即使是错配的DNA寡核苷酸也可以在适当的严格条件下(例如,在 $3\times\text{SSC}$ 、 68°C 条件下杂交,在 $2\times\text{SSC}$ 、 0.1% SDS和 68°C 条件下清洗)与天然型序列杂交,能够对编码天然型序列的DNA进行鉴定、分离,进而这样的基因也能用于本发明。特别是,由于已知大多数生物优先使用特定密码子(最佳密码子)的子集(Gene、Vol.105、pp.61-72、1991等),因此根据宿主微生物进行“密码子最佳化”,这也可用于本发明中。

[0293] 因此,本发明的基因重组微生物以能够表达实质性的酶活性为条件,可包含与上述酶基因的碱基序列具有例如80%、85%、90%、95%、97%、98%或99%以上的序列同源性的碱基序列。或者,本发明的基因重组微生物可包含与编码上述酶的氨基酸序列的碱基序列具有例如80%、85%、90%、95%、97%、98%或99%以上的序列同源性的碱基序列。

[0294] 本发明中,上述二胺化合物合成酶基因组作为“表达盒”被引入宿主微生物细胞内,由此能够更稳定地获得高水平的酶活性。本说明书中,“表达盒”是指包含与表达对象的核酸或表达对象的基因功能性结合的调节转录和翻译的核酸序列的核苷酸。典型地,本发明的表达盒以功能性结合的状态在从编码序列起5'上游包含启动子序列,在3'下游包含终止子序列,根据情况进一步包含通常的调节元件,这种情况下,表达对象的核酸或表达对象的基因被引入宿主微生物中。

[0295] 关于启动子,无论是组成表达型启动子还是诱导表达型启动子,均定义为使RNA聚合酶与DNA结合并启动RNA合成的DNA序列。强启动子是指以高频率启动mRNA合成的启动子,在本发明中也适宜使用。在大肠杆菌中,可以利用lac系、trp系、tac或trc系、 λ 噬菌体的主要操纵基因和启动子区域、fd包被蛋白的控制区、对于糖酵解酶(例如,3-磷酸甘油酸激酶、甘油醛-3-磷酸脱氢酶)、谷氨酸脱羧酶A、丝氨酸羟甲基转移酶的启动子、T7噬菌体来源的RNA聚合酶的启动子区域等。在棒状杆菌(谷氨酸棒状杆菌(*Corynebacterium glutamicum*))中,可以利用HCE(高水平组成型表达)启动子、cspB启动子、sodA启动子、延伸因子(EF-Tu)启动子等。作为终止子,可以利用T7终止子、rrnBT1T2终止子、lac终止子等。除了启动子和终止子序列以外,作为其他调节元件的示例可列举的为选择标记、扩增信号、复制起点等。关于合适的调节序列,例如记载于“Gene Expression Technology:Methods in Enzymology 185”、Academic Press(1990)中。

[0296] 上述说明的表达盒例如被引入质粒、噬菌体、转座子、IS元件、福斯质粒(fosmid)、粘粒、或者线状或环状的DNA等构成的载体中,并插入宿主微生物中。优选质粒和噬菌体。这些载体可以在宿主微生物中自主复制,也可以通过染色体复制。合适的质粒例如为大肠杆菌的pLG338、pACYC184、pBR322、pUC18、pUC19、pKC30、pRep4、pHS1、pKK223-3、pDHE19.2、pHS2、pPlc236、pMBL24、pLG200、pUR290、pIN-III113-B1、 λ gt11或pBdCI;杆菌的pUB110、pC194或pBD214;棒状杆菌属的pSA77或pAJ667等。除此以外可使用的质粒等记载于“Cloning Vectors”、Elsevier、1985中。表达盒向载体的导入可以通过包括利用适当的限制酶进行切割、克隆和连接的惯用方法来进行。各个表达盒可以配置于1个载体上,也可以配置于2个或多个载体。

[0297] 如上构建具有本发明的表达盒的载体后,将该载体引入宿主微生物中时可适用的方法可以采用惯用的方法。可以举出例如氯化钙法、电穿孔法、接合转移法、原生质体融合法等,但不限于此,可以选择适合宿主微生物的方法。

[0298] 为了生产本发明的二胺化合物,如上得到的重组微生物在适合上述重组微生物的生长和/或维持的条件下进行培养和维持。本领域技术人员可以容易地设定适合来自各种宿主微生物的重组微生物的培养基组成、培养条件、培养时间。

[0299] 本发明的另一实施方式涉及利用上述重组微生物制造二胺化合物的方法。制造二胺的方法例如包括下述工序。

[0300] (a) 培养工序

[0301] 二胺化合物的制造方法包括培养上述实施方式的重组微生物的培养工序。例如，利用含有碳源和氮源的培养基培养重组微生物，由此得到包含菌体的培养液。

[0302] 本制造方法可以包括使基因重组微生物接触二胺化合物的前体的步骤。作为向重组微生物供给二胺化合物前体的方法，可以举出：在重组微生物体内生产二胺化合物前体的方法；不依赖于重组微生物体而从细胞外供给二胺化合物前体的方法。

[0303] 在培养工序中，使重组微生物接触二胺化合物的前体的情况下，上述培养基可以进一步包含前体，或者可以在培养工序的途中向培养基中添加前体。

[0304] 培养基可以为包含1种以上的碳源、氮源、无机盐、维生素、以及任意的微量元素或维生素等微量成分的天然、半合成、合成培养基。但是，所使用的培养基当然必须适当地满足所要培养的微生物的营养要求。

[0305] 碳源可以举出D-葡萄糖、蔗糖、乳糖、果糖、麦芽糖、低聚糖、多糖、淀粉、纤维素、米糠、废糖蜜、油脂（例如大豆油、葵花油、花生油、椰子油等）、脂肪酸（例如棕榈酸、亚油酸、油酸、亚麻酸等）、醇（例如甘油、乙醇等）、有机酸（例如乙酸、乳酸、琥珀酸等）。进而可以为含有D-葡萄糖的生物物质。作为合适的生物物质，可示例出玉米分解液、纤维素分解液。这些碳源可以单独使用或以混合物的形式使用。

[0306] 使用生物物质来源的原料制造的二胺化合物可以通过基于ISO16620-2或ASTM D6866中规定的碳-14（放射性碳）分析的生物基碳含量的测定，与例如来自石油、天然气、煤炭等的合成原料明确区分。

[0307] 氮源可以举出含氮有机化合物（例如，蛋白胨、酪蛋白氨基酸、胰蛋白胨、酵母提取物、肉提取物、麦芽提取物、玉米浆、大豆粉、氨基酸和脲等）、或无机化合物（例如，氨水溶液、硫酸铵、氯化铵、磷酸铵、碳酸铵、硝酸钠、硝酸铵等）。这些氮源可以单独使用或以混合物的形式使用。

[0308] 另外，在重组微生物表达有用的附加特性的情况下，例如具有抗生素抗性标记的情况下，培养基可以包含对应的抗生素。由此，培养时杂菌导致的污染风险降低。作为抗生素，可以举出氨苄青霉素等 β -内酰胺系抗生素、卡那霉素等氨基糖苷系抗生素、红霉素等大环内酯系抗生素、四环素系抗生素、氯霉素等，但不限于此。

[0309] 二胺化合物的“前体”是指通过参与本发明的二胺化合物合成的酶能够诱导为二胺化合物的化合物。作为前体，可以举出二羧酸、羧酸半醛、二醛、氨基酸、氨基醛、酰基-ACP、酰基-CoA、酰基磷酸，但不限于此。

[0310] 例如，作为能够诱导为六亚甲基二胺的具体的前体，可以使用己二酸、己二酸半醛、己二醛、6-氨基己酸、6-氨基己醛、己二酰-CoA、磷酸己二酯等。

[0311] 例如，在二胺化合物为六亚甲基二胺的情况下，通过使重组微生物与作为前体的己二酸接触，利用由重组微生物生产的羧酸还原酶和转氨酶，己二酸被转换成六亚甲基二胺。

[0312] 另外，例如，在二胺化合物为1,10-癸二胺的情况下，通过使重组微生物与作为前体的癸二酸接触，利用由重组微生物生产的羧酸还原酶和转氨酶，癸二酸被转换成1,10-癸二胺。

[0313] 前体可以使用1种前体，也可以将2种或2种上的前体进行组合。另外，在可以采取盐形式的化合物的情况下，前体可以以盐的形式使用，可以以游离体的形式使用，还可以使

用它们的混合物。

[0314] 前体的制造方法没有特别限定,可以通过例如化学合成法、酶法、生物转换法、发酵法或它们的组合来制造。

[0315] 在培养工序中,使本发明的基因重组微生物与二胺化合物的前体接触,在培养基中生成累积二胺化合物,由此可以制造二胺化合物。另外,如下所述,在反应工序中,在含有二胺化合物前体的水溶液中使本发明的基因重组微生物发挥作用,由此可以在该反应液中生成累积二胺化合物。

[0316] (b) 反应工序

[0317] 本工序是使二胺化合物的前体与重组微生物接触的工序,由二胺化合物前体生成目标二胺化合物。与二胺的前体的接触例如可以如上所述在上述培养工序中进行,或者也可以在培养工序后进行。在培养工序后进行本反应工序的情况下,使培养工序中得到的培养液和/或菌体与含有二胺化合物的前体的水溶液接触,得到包含二胺化合物的反应液。通过如此与前体接触,在反应液中生成累积二胺化合物。

[0318] 在一个方式中,本工序中,使培养工序中得到的包含菌体的培养液和/或通过离心分离等由在培养工序中得到的培养液中去除了上清的菌体与含有前体的水溶液接触,得到反应液。

[0319] 另外,在另一方式中,可以对通过发酵生产前体的菌与上述本发明的重组微生物进行共培养。通过对它们进行共培养,对于由上述菌生产的前体,能够利用本发明的重组微生物的生产的酶将前体有效地转换成目标二胺化合物。

[0320] 在又一方式中,通过使本发明的基因重组微生物具有二胺化合物前体生产能力,可以由培养基中的成分生成累积二胺化合物。

[0321] 作为利用基因重组微生物的前体生产路径的示例,公开了以葡萄糖为起始原料的6-氨基己酸的制造法(Turk et al.,ACS synthetic biology 5.1(2015):65-73.)、以葡萄糖或甘油为起始原料的己二酸的制造法(Zhao et al.,Metabolic engineering 47(2018):254-262.),但只要能够生产前体就不限定于这些方法。

[0322] 例如,重组微生物具有产生二羧酸、羧酸半醛、或者氨基酸的能力,进而表达转氨酶和羧酸还原酶,由此能够生产二胺化合物。

[0323] 另外,例如,重组微生物具有产生己二酸、己二酸半醛、或者6-氨基己酸的能力,进而表达转氨酶和羧酸还原酶,由此能够生产六亚甲基二胺。

[0324] 根据本发明的基因重组微生物和使用了该微生物的二胺化合物的制造方法,能够抑制副产物的生成,有效地制造二胺化合物。具体而言,例如,在表达二胺化合物的生产所需的酶的微生物中,按照醇脱氢酶的活性与非降低株相比降低的方式进行改变,由此能够抑制作为副产物的醇体的生成,有效地制造二胺化合物。

[0325] 以下,为了进一步说明而给出实施例,因此本发明不限于该实施例。需要说明的是,本说明书中,只要不特别声明,则核苷酸序列从5' 朝向3' 方向进行记载。

[0326] 实施例

[0327] 以下,基于实施例说明本发明,但本发明并不被这些实施例所限定。

[0328] 1:ADH基因破坏株的构建

[0329] <1-a基因破坏用质粒的构建>

[0330] ADH基因的破坏通过使用pHAK1 (2019年3月18日以委托号NITE P-02919保藏于独立行政法人制品评价技术基盘机构生物技术中心专利微生物保藏中心 (NPMD) (地址:千叶县木更津市かずさ鎌足2-5-8 122号室))的同源重组法来进行。pHAK1包含温度敏感性突变型repA基因、卡那霉素耐性基因、枯草杆菌 (*Bacillus subtilis*) 来源的果聚糖蔗糖酶基因 SacB。果聚糖蔗糖酶基因在蔗糖存在下对宿主微生物具有致死作用。PCR片段的扩增使用 PrimeSTAR Max DNA Polymerase (产品名、宝生物制造), 使用大肠杆菌HST08株进行质粒制备。以大肠杆菌BL21 (DE3) 株的基因组DNA为模板, 得到包含破坏靶基因的上游区、编码区和下游区的PCR产物。将靶基因和引物序列的组合示于下表。

[0331] 【表5】

靶基因	正向引物 (序列号)	反向引物 (序列号)
yqhD	TTGTTGAATAAATCGTCTGTTTGCCGA GAATACGCG (序列号 116)	TATCGCATGCAGATCTGCGCTAATGGGCTC CAGGA (序列号 117)
fucO	TTGTTGAATAAATCGCGCGCCAGCGCT GGCTGTTT (序列号 118)	TATCGCATGCAGATCCCGCCAATGCCGGAA GAGTT (序列号 119)
adhP	TTGTTGAATAAATCGCGATCGTGATGC CGCTGTCT (序列号 120)	TATCGCATGCAGATCGACAACGTAGGCTTT GTTCA (序列号 121)
eutG	TTGTTGAATAAATCGCGCCATCTCGAC ACTCTTGA (序列号 122)	TATCGCATGCAGATCGCGAACATCGATGG GTTAGC (序列号 123)
ybbO	TTGTTGAATAAATCGTGGCATTGCCCC TTCCTGTT (序列号 124)	TATCGCATGCAGATCGTCCTGATCCTGCAA CGGAA (序列号 125)
ahr	TTGTTGAATAAATCGCTCATAACGGTA CTGCAAAC (序列号 126)	TATCGCATGCAGATCTCGCAGCAGGTAAG ATGATT (序列号 127)
yahK	TTGTTGAATAAATCGATATTCGTCCTA ACGAACAG (序列号 128)	TATCGCATGCAGATCTTTTGATTTTCAAG TATGT (序列号 129)

[0332] 接着, 使用In-Fusion HD cloning kit (产品名、Clontech公司制造) 将本PCR产物插入至利用序列号130和131的引物进行了扩增的pHAK1质粒片段, 进行环化。

[0334] 【表6】

[0335]	GATCTGCATGCGATATCTCTAGAACGCGTAAGCTT (序列号130)
	TCTCGAGCCGATTATTCACAAAGCCGC (序列号131)

[0336] 以所得到的插入有破坏靶基因的上游区、编码区和下游区的DNA片段的pHAK1质粒为模板, 利用下表中记载的引物进行PCR, 得到去除了破坏靶基因的编码区的一部分区域或全部区域的质粒片段。

[0337] 【表7】

[0338]

靶基因	正向引物(序列号)	反向引物(序列号)
yqhD	ACTTTCGTTTTTCGGGCATTTCGTCC (序列号 132)	CCAATATGAGGGCAGAGAACGATC (序列号 133)
fucO	ATGCGCTGATGTGATAATGC (序列号 134)	CCTTCTCCTTGTTGCTTTA (序列号 135)
adhP	GAGGCCTTTGCTGCGACTGC (序列号 136)	AGTTCCTCCTTTTCGGATGAT (序列号 137)
eutG	ATGCCGGATGCGACGCTT (序列号 138)	TCATTTTGCATATAGCCCCT (序列号 139)
ybbO	TGACCTGGGCAGTAATGGTG (序列号 140)	CAGGATCTCCGTTGCTTTATGAGTC (序列号 141)
ahr	CGTG GTGTTGAAAGCCGATTATTG (序列号 142)	CATAAACTTCCAGTTCTCCGCCC (序列号 143)
yahK	TCGCACACTAACAGACTGAA(序列号 144)	TGTGTTTACTCCTGATTAGC (序列号 145)

[0339] 通过末端磷酸化、自连接将所得到的质粒片段环化,得到基因破坏用质粒。

[0340] <1-b ADH基因破坏大肠杆菌株的构建>

[0341] 通过氯化钙法(参照羊土社基因工学实验笔记田村隆明著)对大肠杆菌BL21(DE3)株转化用于所期望的基因破坏的质粒,之后涂布至含有卡那霉素硫酸盐100mg/L的LB琼脂培养基(胰蛋白胨10g/L、酵母提取物5g/L、氯化钠5g/L、琼脂末15g/L)上,在30℃培养一晚,取得单个菌落,得到转化体。将一白金环的本转化体接种到含有卡那霉素硫酸盐100mg/L的LB液体培养基(胰蛋白胨10g/L、酵母提取物5g/L、氯化钠5g/L)1mL中,在30℃进行振荡培养。将所得到的培养液涂布到含有卡那霉素硫酸盐100mg/L的LB琼脂培养基上,在42℃培养一晚。所得到的菌落通过单交叉在基因组中插入有质粒。将一白金环的菌落接种到LB液体培养基1mL中,在30℃进行振荡培养。将所得到的培养液涂布至含有蔗糖10%的LB琼脂培养基,培养一晚。对于所得到的菌落,利用表8所示的引物组,通过菌落直接PCR确认所期望的基因遭到了破坏。将构建的ADH基因破坏大肠杆菌株示于表9。表中,Δ表示该酶基因缺损。

[0342] 【表8】

[0343]

靶基因	正向引物(序列号)	反向引物(序列号)
yqhD	TATTCTCAATCCGTTTCAGCACGCG (序列号 146)	TTCGGGATCACCACCAGGCCG (序列号 147)
fucO	CGGAAATGGACGAACAGTGG (序列号 148)	CGTCATCAGCGTTTACCAGATT (序列号 149)
adhP	GCATAAACACTGTCCGCGTC (序列号 150)	GAAATCGAGAAGGCAGAAGCGAAA (序列号 151)
eutG	GGTGCGGTCACCATTGTTCG (序列号 152)	CATATCGCACGCCAGCAGTG (序列号 153)
ybbO	GGTGAGGATGGAGAGTTCATG (序列号 154)	CAGTTCGATTTGCGCCACCAG (序列号 155)
ahr	TCCGCTAGTGTGATTTTCAGG (序列号 156)	GAAATTATTATGCCGCCAGGCGT (序列号 157)
yahK	TTATGGTCTGGGCGACATGC (序列号 158)	GCATCATCCTGGTCATATACCC (序列号 159)

[0344]

【表9】

[0345]

BL21 (DE3) Δ yqhD
BL21 (DE3) Δ fucO
BL21 (DE3) Δ adhP
BL21 (DE3) Δ eutG
BL21 (DE3) Δ ybbO
BL21 (DE3) Δ ahr
BL21 (DE3) Δ yahK
BL21 (DE3) Δ yqhD Δ fucO
BL21 (DE3) Δ yqhD Δ adhP
BL21 (DE3) Δ yqhD Δ eutG
BL21 (DE3) Δ yqhD Δ ybbO
BL21 (DE3) Δ yqhD Δ ahr
BL21 (DE3) Δ yqhD Δ yahK
BL21 (DE3) Δ yqhD Δ fucO Δ adhP
BL21 (DE3) Δ yqhD Δ fucO Δ adhP Δ eutG
BL21 (DE3) Δ yqhD Δ fucO Δ adhP Δ eutG Δ ybbO
BL21 (DE3) Δ yqhD Δ fucO Δ adhP Δ eutG Δ ybbO Δ ahr
BL21 (DE3) Δ yqhD Δ fucO Δ adhP Δ eutG Δ ybbO Δ ahr Δ yahK

[0346] <1-c 1,6-己二醇的分解活性降低试验>

[0347] 通过1,6-己二醇的氧化反应的进行对所构建的ADH基因破坏大肠杆菌株的1,6-己二醇的分解活性降低进行了确认。1,6-己二醇是伴随着六亚甲基二胺的生产反应作为副产物生成的醇体之一。本试验中,基于图1所示的ADH催化的醛与醇之间的反应是可逆反应,着眼于由醇(此处为1,6-己二醇)向醛的转换反应,将1,6-己二醇的消耗作为基于ADH的1,6-

己二醇的分解活性的指标。本试验中,作为预培养,将一白金环的ADH基因破坏大肠杆菌各株的菌体接种到LB液体培养基2mL中,在37℃进行一晚振荡培养。将所得到的预培养液以1%相当量接种到包含1,6-己二醇10mM的LB液体培养基2mL中,作为正式培养,在37℃进行48小时振荡培养。通过离心分离将培养液分离成菌体和上清,分析上清中的1,6-己二醇浓度。

[0348] 1,6-己二醇浓度的分析使用气相色谱进行。

[0349] 条件如下。

[0350] GC系统:GC-2010(岛津制作所制造)

[0351] 检测器:氢焰离子化检测器

[0352] 柱:DB-WAX (Agilent公司制造、柱长30m、内径0.25mm、膜厚0.25mm)

[0353] 载气:He

[0354] 气体压力:100kPa

[0355] 柱温:50℃ - (25℃/min) - 230℃ - (保持20min)

[0356] 检测器温度:250℃

[0357] 注入口温度:250℃

[0358] 注入量:1μL

[0359] 注入方法:分流进样法(分流比36.3)

[0360] 将正式培养48小时后的培养上清中的1,6-己二醇浓度示于图2。在未破坏ADH基因的野生型株(BL21 (DE3)株,WT是Wild Type的缩写,表示野生型)的情况下,通过ADH的作用而消耗1,6-己二醇,与之相对,在ADH基因破坏株、特别是`ahr`基因、`yahK`基因这两种基因的情况下,通过单独的基因破坏抑制了1,6-己二醇的消耗。根据本结果,在ADH基因破坏株中确认到了1,6-己二醇的分解活性的降低。

[0361] 2:ADH基因破坏株中的二胺化合物生产

[0362] <2-a `MaCar`基因、`Npt`基因、`ygjG`基因表达质粒的构建>

[0363] PCR片段的扩增使用了PrimeSTAR Max DNA Polymerase(产品名、宝生物制造),质粒的制备使用了大肠杆菌JM109株。以大肠杆菌(*Escherichia coli*) W3110株(NBRC12713)的基因组DNA为模板,以序列号160和161的寡核苷酸为引物而进行PCR,得到包含`ygjG`基因的编码区的PCR产物。接着,使用In-Fusion HD cloning kit(产品名、Clontech公司制造)将本PCR产物插入质粒pACYCDuet (商标) -1(产品名、Merck公司制造)的限制酶NcoI和HindIII切割部位间,命名为“pDA50”。

[0364] 【表10】

[0365] ATAAGGAGATATACCATGATACGCGAGCCTCCGGA(序列号160)

ATGCGGCCGCAAGCTTTACGCTTCTTCGACACTTA(序列号161)

[0366] 以脓肿分枝杆菌(*Mycobacterium abscessus*) JCM13569株(通过文部科学省/国立研究开发法人日本医疗研究开发机构国家生物资源项目由理研BRC提供)的基因组DNA为模板,以序列号162和163的寡核苷酸为引物而进行PCR,得到包含`MaCar`基因的编码区的PCR产物。接着,使用In-Fusion HD cloning kit(产品名、Clontech公司制造)将本PCR产物插入pDA50的限制酶NdeI和AvrII切割部位间,命名为“pDA52”。

[0367] 【表11】

[0368]	TAAGAAGGAGATATACATATGACTGAAACGATCTC (序列号162)
	GTGGCAGCAGCCTAGCTACACCAGGCCCAACAGCT (序列号163)

[0369] 以艾阿华诺卡氏菌 (*Nocardia iowensis*) JCM18299株 (通过文部科学省国家生物资源项目由理研BRC提供) 的基因组DNA为模板, 以序列号164和165的寡核苷酸为引物而进行PCR, 得到包含Npt基因的编码区的PCR产物。接下来, 以pDA52为模板, 以序列号166和167的寡核苷酸为引物而进行PCR, 得到pDA52片段。使用In-Fusion HD cloning kit (产品名、Clontech公司制造) 将PCR产物彼此连接。从所得到的转化体提取质粒, 将插入有Npt基因的质粒命名为“pDA56”。将pDA56的质粒图示于图3。

[0370] 【表12】

[0371]	TTTAAGGAGTTCGATATGATCGAGACAATTTTGCC (序列号164)
	GGTGGCAGCAGCCTAGTCAGGCGTACGCGATCGCG (序列号165)
	CTAGGCTGCTGCCACCGCTG (序列号166)
	ATCGAACTCCTTAAATTTATCTACACCAGGCCCAACAGCT (序列号167)

[0372] <2-b转化体的制作>

[0373] 通过氯化钙法 (参照羊土社基因工学实验笔记田村隆明著), 将pDA56引入ADH基因非破坏大肠杆菌株或ADH基因破坏株中, 利用含有氯霉素34mg/L的LB琼脂培养基培养一晚, 得到转化体。如下表所示, 将取得的转化体分别命名为转化体A~S。如表中所示, 转化体A为ADH基因非破坏株, 转化体B~H为编码ADH的基因中的任一个被破坏的菌株, 转化体I~S为编码ADH的基因中的至少2个被破坏 (多重破坏) 的菌株。

[0374] 【表13】

[0375]

转化体名	菌株	质粒
A	BL21(DE3)	pDA56
B	BL21(DE3) $\Delta yqhD$	
C	BL21(DE3) $\Delta fucO$	
D	BL21(DE3) $\Delta adhP$	
E	BL21(DE3) $\Delta eutG$	
F	BL21(DE3) $\Delta ybbO$	
G	BL21(DE3) Δahr	
H	BL21(DE3) $\Delta yahK$	
I	BL21(DE3) $\Delta yqhD \Delta fucO$	
J	BL21(DE3) $\Delta yqhD \Delta adhP$	
K	BL21(DE3) $\Delta yqhD \Delta eutG$	
L	BL21(DE3) $\Delta yqhD \Delta ybbO$	
M	BL21(DE3) $\Delta yqhD \Delta ahr$	
N	BL21(DE3) $\Delta yqhD \Delta yahK$	
O	BL21(DE3) $\Delta yqhD \Delta fucO \Delta adhP$	
P	BL21(DE3) $\Delta yqhD \Delta fucO \Delta adhP \Delta eutG$	
Q	BL21(DE3) $\Delta yqhD \Delta fucO \Delta adhP \Delta eutG \Delta ybbO$	
R	BL21(DE3) $\Delta yqhD \Delta fucO \Delta adhP \Delta eutG \Delta ybbO \Delta ahr$	
S	BL21(DE3) $\Delta yqhD \Delta fucO \Delta adhP \Delta eutG \Delta ybbO \Delta ahr \Delta yahK$	

[0376] <2-c由己二酸生产六亚甲基二胺(比较例1、实施例1~18)>

[0377] 作为预培养,将一白金环的转化体A~S的菌体接种到包含氯霉素34mg/L的LB液体培养基2mL中,在37℃进行一晚振荡培养。将所得到的预培养液以1%相当量接种到含有己二酸二铵50mM、氯霉素34mg/L、葡萄糖2%的SOB液体培养基(胰蛋白胨20g/L、酵母提取物5g/L、氯化钠0.5g/L、氯化钾2.5mM、硫酸镁10mM、氯化镁10mM)1mL中,在37℃进行振荡培养。培养2小时后,按照最终浓度为0.2mM的方式添加异丙基-β-硫代半乳糖吡喃糖苷(IPTG),在30℃进行48小时振荡培养。通过离心分离将培养液分离成菌体和上清,分析上清中的六亚甲基二胺浓度和1,6-己二醇浓度。

[0378] 六亚甲基二胺浓度的分析使用离子色谱进行。条件如下。

[0379] 装置:ICS-3000 (Dionex公司制造)

[0380] 检测器:电导率检测器

[0381] 柱:IonPac CG19 (2×50mm) /CS19 (2×250mm) (Thermo Scientific公司制造)

[0382] 烘箱温度:30℃

[0383] 流动相:8mM甲磺酸水溶液(A)、70mM甲磺酸水溶液(B)

[0384] 梯度条件:(A:100%、B:0%)-(10min)-(A:0%、B:100%)-(保持1min)

[0385] 流速:0.35mL/min

[0386] 注入量:20μL

[0387] 在与(1-c)同样的条件下使用气相色谱进行1,6-己二醇浓度的分析。

[0388] 表14中示出各培养液中的六亚甲基二胺浓度、1,6-己二醇浓度。首先,关于六亚甲基二胺浓度,与ADH基因非破坏株(比较例1)相比,在实施例1、3和8~18的ADH基因破坏株中

确认到六亚甲基二胺生成量的增加。另外,在实施例1、2和4~18的ADH基因破坏株中,1,6-己二醇生成量降低。另外,由于ADH基因的多重破坏(实施例8~18),六亚甲基二胺生成量进一步增加,关于1,6-己二醇浓度,与ADH基因非破坏株(比较例1)相比确认到生成的抑制。

[0389] 【表14】

	转化体	六亚甲基二胺浓度 (μ M)	1,6-己二醇浓度 (mM)
比较例1	A	2	1.70
实施例1	B	10	0.22
实施例2	C	2	1.41
实施例3	D	4	2.01
实施例4	E	2	1.57
实施例5	F	1	1.18
实施例6	G	2	1.30
实施例7	H	2	1.28
实施例8	I	38	0.27
实施例9	J	81	0.38
实施例10	K	48	0.29
实施例11	L	18	0.18
实施例12	M	69	0.08
实施例13	N	63	0.26
实施例14	O	68	0.31
实施例15	P	54	0.28
实施例16	Q	42	0.24
实施例17	R	38	0.09
实施例18	S	47	0.05

[0391] <2-d由癸二酸生产1,10-癸二胺(比较例2、实施例19、20)>

[0392] 作为预培养,将一白金环的转化体A~S的菌体接种到包含氯霉素34mg/L的LB液体培养基2mL中,在37℃进行一晚振荡培养。将所得到的预培养液以1%相当量接种到含有癸二酸钠50mM、氯霉素34mg/L、葡萄糖2%的SOB液体培养基1mL中,在37℃振荡培养。培养2小时后,按照最终浓度为0.2mM的方式添加IPTG,在30℃进行48小时振荡培养。通过离心分离将培养液分离成菌体和上清,分析上清中的1,10-癸二胺浓度和1,10-癸二醇浓度。

[0393] 1,10-癸二胺浓度的分析在与(2-c)同样的条件下通过离子色谱进行。表15中示出各培养液中的1,10-癸二胺浓度。与ADH基因非破坏株(比较例2)相比,在实施例19和20的ADH基因破坏株中确认到1,10-二氨基癸烷生成量的增加。

[0394] 1,10-癸二醇的浓度的分析在与(1-c)同样的条件下使用气相色谱进行。表15中示出各培养液中的1,10-癸二胺浓度。与ADH基因非破坏株(比较例2)相比,在实施例19和20的ADH基因破坏株中确认到1,10-癸二醇生成量的抑制。

[0395] 【表15】

[0396]

	转化体	1, 10-癸二胺浓度 (μ M)	1, 10-癸二醇浓度 (mM)
比较例 2	A	107	1.03
实施例 19	B	199	0.55
实施例 20	S	228	0.57

[0397] 生物学材料的保藏

[0398] 质粒pHAK1于2020年7月21日以“NITE ABP-02919(受理编号)”保藏于独立行政法人制品评价技术基盘机构专利微生物保藏中心(NPMD)(地址:日本国千葉県木更津市かずさ鎌足2-5-8 122号室)(由NITE P-02919向基于布达佩斯条约的保藏的移交)。

[0399] 工业实用性

[0400] 本发明的基因重组微生物能够适宜地用于二胺化合物制造。

序列表

<110> 旭化成株式会社

<120> 基因重组微生物和二胺化合物的制造方法

<130> 190379W001

<150> JP2019-134306

<151> 2019-07-22

<160> 167

<170> PatentIn version 3.5

<210> 1

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<212> PRT

<213> 大肠杆菌

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           20           25           30
Leu Ile Thr Tyr Gly Gly Gly Ser Val Lys Lys Thr Gly Val Leu Asp
           35           40           45
Gln Val Leu Asp Ala Leu Lys Gly Met Asp Val Leu Glu Phe Gly Gly
           50           55           60
Ile Glu Pro Asn Pro Ala Tyr Glu Thr Leu Met Asn Ala Val Lys Leu
65           70           75           80
Val Arg Glu Gln Lys Val Thr Phe Leu Leu Ala Val Gly Gly Gly Ser
           85           90           95
Val Leu Asp Gly Thr Lys Phe Ile Ala Ala Ala Asn Tyr Pro Glu
           100          105          110
Asn Ile Asp Pro Trp His Ile Leu Gln Thr Gly Gly Lys Glu Ile Lys
           115          120          125
Ser Ala Ile Pro Met Gly Cys Val Leu Thr Leu Pro Ala Thr Gly Ser
           130          135          140
Glu Ser Asn Ala Gly Ala Val Ile Ser Arg Lys Thr Thr Gly Asp Lys
145          150          155          160
Gln Ala Phe His Ser Ala His Val Gln Pro Val Phe Ala Val Leu Asp
           165          170          175
Pro Val Tyr Thr Tyr Thr Leu Pro Pro Arg Gln Val Ala Asn Gly Val
           180          185          190
Val Asp Ala Phe Val His Thr Val Glu Gln Tyr Val Thr Lys Pro Val

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195	200	205
Asp Ala Lys Ile Gln Asp Arg Phe Ala Glu Gly Ile Leu Leu Thr Leu		
210	215	220
Ile Glu Asp Gly Pro Lys Ala Leu Lys Glu Pro Glu Asn Tyr Asp Val		
225	230	235
Arg Ala Asn Val Met Trp Ala Ala Thr Gln Ala Leu Asn Gly Leu Ile		
245	250	255
Gly Ala Gly Val Pro Gln Asp Trp Ala Thr His Met Leu Gly His Glu		
260	265	270
Leu Thr Ala Met His Gly Leu Asp His Ala Gln Thr Leu Ala Ile Val		
275	280	285
Leu Pro Ala Leu Trp Asn Glu Lys Arg Asp Thr Lys Arg Ala Lys Leu		
290	295	300
Leu Gln Tyr Ala Glu Arg Val Trp Asn Ile Thr Glu Gly Ser Asp Asp		
305	310	315
Glu Arg Ile Asp Ala Ala Ile Ala Ala Thr Arg Asn Phe Phe Glu Gln		
325	330	335
Leu Gly Val Pro Thr His Leu Ser Asp Tyr Gly Leu Asp Gly Ser Ser		
340	345	350
Ile Pro Ala Leu Leu Lys Lys Leu Glu Glu His Gly Met Thr Gln Leu		
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Gly Glu Asn His Asp Ile Thr Leu Asp Val Ser Arg Arg Ile Tyr Glu		
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Ala Ala Arg

385

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<211> 1164

<212> DNA

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gttcgcgaac agaaagtgc tttcctgctg gcggttggcg gcggttctgt actggacggc 300
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 gaacagtatg ttaccaaacc ggttgatgcc aaaattcagg accgtttcgc agaaggcatt 660
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 cgcgctaagc tgctgcaata tgctgaacgc gtctggaaca tcactgaagg ttccgatgat 960
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 acccacctct ccgactacgg tctggacggc agtccatcc cggctttgct gaaaaaactg 1080
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<210> 3

<211> 383

<212> PRT

<213> 大肠杆菌

<400> 3

Met	Met	Ala	Asn	Arg	Met	Ile	Leu	Asn	Glu	Thr	Ala	Trp	Phe	Gly	Arg
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Gly	Ala	Val	Gly	Ala	Leu	Thr	Asp	Glu	Val	Lys	Arg	Arg	Gly	Tyr	Gln
			20					25					30		
Lys	Ala	Leu	Ile	Val	Thr	Asp	Lys	Thr	Leu	Val	Gln	Cys	Gly	Val	Val
			35					40					45		
Ala	Lys	Val	Thr	Asp	Lys	Met	Asp	Ala	Ala	Gly	Leu	Ala	Trp	Ala	Ile
			50					55					60		
Tyr	Asp	Gly	Val	Val	Pro	Asn	Pro	Thr	Ile	Thr	Val	Val	Lys	Glu	Gly
65					70				75					80	
Leu	Gly	Val	Phe	Gln	Asn	Ser	Gly	Ala	Asp	Tyr	Leu	Ile	Ala	Ile	Gly
				85				90						95	
Gly	Gly	Ser	Pro	Gln	Asp	Thr	Cys	Lys	Ala	Ile	Gly	Ile	Ile	Ser	Asn
			100					105						110	
Asn	Pro	Glu	Phe	Ala	Asp	Val	Arg	Ser	Leu	Glu	Gly	Leu	Ser	Pro	Thr
			115					120						125	
Asn	Lys	Pro	Ser	Val	Pro	Ile	Leu	Ala	Ile	Pro	Thr	Thr	Ala	Gly	Thr
			130					135						140	
Ala	Ala	Glu	Val	Thr	Ile	Asn	Tyr	Val	Ile	Thr	Asp	Glu	Glu	Lys	Arg
145					150					155				160	
Arg	Lys	Phe	Val	Cys	Val	Asp	Pro	His	Asp	Ile	Pro	Gln	Val	Ala	Phe
				165						170				175	
Ile	Asp	Ala	Asp	Met	Met	Asp	Gly	Met	Pro	Pro	Ala	Leu	Lys	Ala	Ala

180	185	190
Thr Gly Val Asp Ala Leu Thr His	Ala Ile Glu Gly Tyr Ile Thr Arg	
195	200	205
Gly Ala Trp Ala Leu Thr Asp Ala	Leu His Ile Lys Ala Ile Glu Ile	
210	215	220
Ile Ala Gly Ala Leu Arg Gly Ser	Val Ala Gly Asp Lys Asp Ala Gly	
225	230	235
Glu Glu Ile Ala Leu Gly Gln Tyr	Val Ala Gly Met Gly Phe Ser Asn	
245	250	255
Val Gly Leu Gly Leu Val His Gly	Met Ala His Pro Leu Gly Ala Phe	
260	265	270
Tyr Asn Thr Pro His Gly Val Ala	Asn Ala Ile Leu Leu Pro His Val	
275	280	285
Met Arg Tyr Asn Ala Asp Phe Thr	Gly Glu Lys Tyr Arg Asp Ile Ala	
290	295	300
Arg Val Met Gly Val Lys Val Glu	Gly Met Ser Leu Glu Glu Ala Arg	
305	310	315
Asn Ala Ala Val Glu Ala Val Phe	Ala Leu Asn Arg Asp Val Gly Ile	
325	330	335
Pro Pro His Leu Arg Asp Val Gly	Val Arg Lys Glu Asp Ile Pro Ala	
340	345	350
Leu Ala Gln Ala Ala Leu Asn Asp	Val Cys Thr Gly Gly Asn Pro Arg	
355	360	365
Glu Ala Thr Leu Glu Asp Ile Val	Glu Leu Tyr His Thr Ala Trp	
370	375	380

<210> 4

<211> 1152

<212> DNA

<213> 大肠杆菌

<400> 4

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acgctgggtgc aatgcggcgt ggtggcgaaa gtgaccgata agatggatgc tgcagggctg 180
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agcctggaag ggctttcccc gaccaataaa cccagtgtac cgattctggc aatccccacc 420
acagcaggca ctgcggcaga agtgaccatt aactacgtga tcaactgacga agaaaaacgg 480
cgcaagtttg tttgcgttga tccgcatgat atccgcgagg tggcgtttat tgacgctgac 540

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 gcgattgaaa tcattgctgg ggcgctgcga ggatcggttg ctggtgataa ggatgccgga 720
 gaagaaatag cgctcgggca gatatgttgcg ggtatgggct tctcgaatgt tgggttaggg 780
 ttggtgcatg gtatggcgca tccactgggc gcgttttata aactccaca cggtgttgca 840
 aacgccatcc tgctaccgca tgtcatgcgc tataacgctg actttaccgg tgagaagtac 900
 cgcgatatcg cgcgcgttat gggcgtgaaa gtggaaggta tgagcctgga agaggcgcgt 960
 aatgccgctg ttgaagcggg gtttgccttc aaccgtgatg tcggtattcc gccacatttg 1020
 cgtgatgttg gggtagcga ggaagacatt ccggcactgg cgcaggcggc actgaatgat 1080
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<210> 5

<211> 336

<212> PRT

<213> 大肠杆菌

<400> 5

Met	Lys	Ala	Ala	Val	Val	Thr	Lys	Asp	His	His	Val	Asp	Val	Thr	Tyr
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Lys	Thr	Leu	Arg	Ser	Leu	Lys	His	Gly	Glu	Ala	Leu	Leu	Lys	Met	Glu
				20				25					30		
Cys	Cys	Gly	Val	Cys	His	Thr	Asp	Leu	His	Val	Lys	Asn	Gly	Asp	Phe
				35				40					45		
Gly	Asp	Lys	Thr	Gly	Val	Ile	Leu	Gly	His	Glu	Gly	Ile	Gly	Val	Val
				50				55					60		
Ala	Glu	Val	Gly	Pro	Gly	Val	Thr	Ser	Leu	Lys	Pro	Gly	Asp	Arg	Ala
65						70				75					80
Ser	Val	Ala	Trp	Phe	Tyr	Glu	Gly	Cys	Gly	His	Cys	Glu	Tyr	Cys	Asn
				85				90					95		
Ser	Gly	Asn	Glu	Thr	Leu	Cys	Arg	Ser	Val	Lys	Asn	Ala	Gly	Tyr	Ser
				100				105					110		
Val	Asp	Gly	Gly	Met	Ala	Glu	Glu	Cys	Ile	Val	Val	Ala	Asp	Tyr	Ala
				115				120					125		
Val	Lys	Val	Pro	Asp	Gly	Leu	Asp	Ser	Ala	Ala	Ala	Ser	Ser	Ile	Thr
				130				135					140		
Cys	Ala	Gly	Val	Thr	Thr	Tyr	Lys	Ala	Val	Lys	Leu	Ser	Lys	Ile	Arg
145						150				155					160
Pro	Gly	Gln	Trp	Ile	Ala	Ile	Tyr	Gly	Leu	Gly	Gly	Leu	Gly	Asn	Leu
				165						170				175	
Ala	Leu	Gln	Tyr	Ala	Lys	Asn	Val	Phe	Asn	Ala	Lys	Val	Ile	Ala	Ile

180	185	190
Asp Val Asn Asp Glu Gln Leu Lys Leu Ala Thr Glu Met Gly Ala Asp		
195	200	205
Leu Ala Ile Asn Ser His Thr Glu Asp Ala Ala Lys Ile Val Gln Glu		
210	215	220
Lys Thr Gly Gly Ala His Ala Ala Val Val Thr Ala Val Ala Lys Ala		
225	230	235
Ala Phe Asn Ser Ala Val Asp Ala Val Arg Ala Gly Gly Arg Val Val		
245	250	255
Ala Val Gly Leu Pro Pro Glu Ser Met Ser Leu Asp Ile Pro Arg Leu		
260	265	270
Val Leu Asp Gly Ile Glu Val Val Gly Ser Leu Val Gly Thr Arg Gln		
275	280	285
Asp Leu Thr Glu Ala Phe Gln Phe Ala Ala Glu Gly Lys Val Val Pro		
290	295	300
Lys Val Ala Leu Arg Pro Leu Ala Asp Ile Asn Thr Ile Phe Thr Glu		
305	310	315
Met Glu Glu Gly Lys Ile Arg Gly Arg Met Val Ile Asp Phe Arg His		
325	330	335

<210> 6

<211> 1011

<212> DNA

<213> 大肠杆菌

<400> 6

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agcgtggcgt ggttctacga aggatgcggt cattgcgaat actgtaacag tggtaacgaa 300
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tgcacgtggg tcgccgatta cgcggtaaaa gtgccagatg gtctggactc ggcggcggcc 420
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gcgaagaatg tctttaacgc caaagtgatc gccattgatg tcaatgatga gcagttaaaa 600
ctggcaaccg aaatgggcgc agatttagcg attaactcac acaccgaaga cgccgcaaaa 660
attgtgcagg agaaaactgg tggcgtcac gctgcggtgg taacagcggg agctaaagct 720
gcgtttaact cggcagttga tgctgtccgt gcaggcggtc gtgttggtgc tgcggtcta 780
ccgccggagt ctatgagcct ggatatccca cgtcttgtgc tggatggtat tgaagtgttc 840
ggttcgctgg tcggcacgcg ccaggattta actgaagcct tccagtttgc cgccgaaggt 900

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aaagtgggtgc cgaaagtcgc cctgcgtccg ttagcggaca tcaacaccat ctttactgag 960
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<210> 7
<211> 269
<212> PRT
<213> 大肠杆菌
<400> 7
Met Thr His Lys Ala Thr Glu Ile Leu Thr Gly Lys Val Met Gln Lys
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Ser Val Leu Ile Thr Gly Cys Ser Ser Gly Ile Gly Leu Glu Ser Ala
          20          25          30
Leu Glu Leu Lys Arg Gln Gly Phe His Val Leu Ala Gly Cys Arg Lys
          35          40          45
Pro Asp Asp Val Glu Arg Met Asn Asn Met Gly Phe Thr Gly Val Leu
          50          55          60
Ile Asp Leu Asp Ser Pro Glu Ser Val Asp Arg Ala Ala Asp Glu Val
65          70          75          80
Ile Ala Leu Thr Asp Asn Cys Leu Tyr Gly Ile Phe Asn Asn Ala Gly
          85          90          95
Phe Gly Met Tyr Gly Pro Leu Ser Thr Ile Ser Arg Ala Gln Met Glu
          100          105          110
Gln Gln Phe Ser Ala Asn Phe Phe Gly Ala His Gln Leu Thr Met Arg
          115          120          125
Leu Leu Pro Ala Met Leu Pro His Gly Glu Gly Arg Ile Val Met Thr
          130          135          140
Ser Ser Val Met Gly Leu Ile Ser Thr Pro Gly Arg Gly Ala Tyr Ala
145          150          155          160
Ala Ser Lys Tyr Ala Leu Glu Ala Trp Ser Asp Ala Leu Arg Met Glu
          165          170          175
Leu Arg His Ser Gly Ile Lys Val Ser Leu Ile Glu Pro Gly Pro Ile
          180          185          190
Arg Thr Arg Phe Thr Asp Asn Val Asn Gln Thr Gln Ser Asp Lys Pro
          195          200          205
Val Glu Asn Pro Gly Ile Ala Ala Arg Phe Thr Leu Gly Pro Glu Ala
          210          215          220
Val Val Asp Lys Val Arg His Ala Phe Ile Ser Glu Lys Pro Lys Met
225          230          235          240
Arg Tyr Pro Val Thr Leu Val Thr Trp Ala Val Met Val Leu Lys Arg
          245          250          255

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Leu Leu Pro Gly Arg Val Met Asp Lys Ile Leu Gln Gly

260

265

<210> 8

<211> 810

<212> DNA

<213> 大肠杆菌

<400> 8

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catgtgctgg caggttgccg aaaaccggat gatgttgagc gtatgaacaa catgggattt 180
accggcgtgt tgatcgatct ggattcacca gaaagtgttg atcgcgcagc agacgaggtg 240
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attgtgatga catcatcggt gatgggatta atctccacgc cgggtcgtgg cgcttacgcg 480
gccagtaa atgcgctgga ggctgtgtca gacgcgctgc gcatggagct acgccacagc 540
ggaattaaag tcagcctgat cgaacccggt cccattcgta ctgccttcac cgacaacgtc 600
aaccagacgc aaagtataaa accagtcgaa aatccccgca tcgccgccc ctttacgttg 660
ggaccggaag cgggtgtgga caaagtacgc catgctttta ttagcgagaa gccgaagatg 720
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cgctgatggg acaaaatatt gcagggtga 810
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<210> 9

<211> 395

<212> PRT

<213> 大肠杆菌

<400> 9

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Asn Leu Gln Arg Val Lys Thr Phe Ser Val Pro Pro Val Thr Leu Cys
20        25        30
Gly Pro Gly Ala Val Ser Ser Cys Gly Gln Gln Ala Gln Thr Arg Gly
35        40        45
Leu Lys His Leu Phe Val Met Ala Asp Ser Phe Leu His Gln Ala Gly
50        55        60
Met Thr Ala Gly Leu Thr Arg Ser Leu Ala Val Lys Gly Ile Ala Met
65        70        75        80
Thr Leu Trp Pro Cys Pro Val Gly Glu Pro Cys Ile Thr Asp Val Cys
85        90        95
Ala Ala Val Ala Gln Leu Arg Glu Ser Gly Cys Asp Gly Val Ile Ala
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100	105	110
Phe Gly Gly Gly Ser Val Leu Asp	Ala Ala Lys Ala Val	Ala Leu Leu
115	120	125
Val Thr Asn Pro Asp Ser Thr	Leu Ala Glu Met Ser Glu Thr	Ser Val
130	135	140
Leu Gln Pro Arg Leu Pro Leu Ile	Ala Ile Pro Thr Thr	Ala Gly Thr
145	150	155
Gly Ser Glu Thr Thr Asn Val Thr	Val Ile Ile Asp Ala Val	Ser Gly
165	170	175
Arg Lys Gln Val Leu Ala His	Ala Ser Leu Met Pro Asp	Val Ala Ile
180	185	190
Leu Asp Ala Ala Leu Thr Glu Gly	Val Pro Ser His Val Thr	Ala Met
195	200	205
Thr Gly Ile Asp Ala Leu Thr His	Ala Ile Glu Ala Tyr Ser	Ala Leu
210	215	220
Asn Ala Thr Pro Phe Thr Asp	Ser Leu Ala Ile Gly Ala Ile	Ala Met
225	230	235
Ile Gly Lys Ser Leu Pro Lys Ala	Val Gly Tyr Gly His Asp	Leu Ala
245	250	255
Ala Arg Glu Ser Met Leu Leu Ala	Ser Cys Met Ala Gly Met	Ala Phe
260	265	270
Ser Ser Ala Gly Leu Gly Leu Cys	His Ala Met Ala His Gln	Pro Gly
275	280	285
Ala Ala Leu His Ile Pro His Gly	Leu Ala Asn Ala Met Leu	Leu Pro
290	295	300
Thr Val Met Glu Phe Asn Arg	Met Val Cys Arg Glu Arg	Phe Ser Gln
305	310	315
Ile Gly Arg Ala Leu Arg Thr Lys	Lys Ser Asp Asp Arg Asp	Ala Ile
325	330	335
Asn Ala Val Ser Glu Leu Ile Ala	Glu Val Gly Ile Gly Lys Arg	Leu
340	345	350
Gly Asp Val Gly Ala Thr Ser	Ala His Tyr Gly Ala Trp	Ala Gln Ala
355	360	365
Ala Leu Glu Asp Ile Cys Leu Arg	Ser Asn Pro Arg Thr Ala	Ser Leu
370	375	380
Glu Gln Ile Val Gly Leu Tyr	Ala Ala Ala Gln	
385	390	395
<210> 10		
<211> 1188		

<212> DNA

<213> 大肠杆菌

<400> 10

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cattacggcg catgggcgca ggccgcgctg gaagatattt gtctgcgcag taaccgcgt 1140
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<210> 11

<211> 339

<212> PRT

<213> 大肠杆菌

<400> 11

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Glu Val Tyr Glu Tyr Asp Pro Gly Glu Leu Arg Pro Gln Asp Val Glu
          20           25           30
Val Gln Val Asp Tyr Cys Gly Ile Cys His Ser Asp Leu Ser Met Ile
          35           40           45
Asp Asn Glu Trp Gly Phe Ser Gln Tyr Pro Leu Val Ala Gly His Glu
          50           55           60
Val Ile Gly Arg Val Val Ala Leu Gly Ser Ala Ala Gln Asp Lys Gly
65           70           75           80
Leu Gln Val Gly Gln Arg Val Gly Ile Gly Trp Thr Ala Arg Ser Cys

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	85		90		95
Gly His Cys Asp Ala Cys Ile Ser Gly Asn Gln Ile Asn Cys Glu Gln					
100		105		110	
Gly Ala Val Pro Thr Ile Met Asn Arg Gly Gly Phe Ala Glu Lys Leu					
115		120		125	
Arg Ala Asp Trp Gln Trp Val Ile Pro Leu Pro Glu Asn Ile Asp Ile					
130		135		140	
Glu Ser Ala Gly Pro Leu Leu Cys Gly Gly Ile Thr Val Phe Lys Pro					
145		150		155	
Leu Leu Met His His Ile Thr Ala Thr Ser Arg Val Gly Val Ile Gly					
165		170		175	
Ile Gly Gly Leu Gly His Ile Ala Ile Lys Leu Leu His Ala Met Gly					
180		185		190	
Cys Glu Val Thr Ala Phe Ser Ser Asn Pro Ala Lys Glu Gln Glu Val					
195		200		205	
Leu Ala Met Gly Ala Asp Lys Val Val Asn Ser Arg Asp Pro Gln Ala					
210		215		220	
Leu Lys Ala Leu Ala Gly Gln Phe Asp Leu Ile Ile Asn Thr Val Asn					
225		230		235	
Val Ser Leu Asp Trp Gln Pro Tyr Phe Glu Ala Leu Thr Tyr Gly Gly					
245		250		255	
Asn Phe His Thr Val Gly Ala Val Leu Thr Pro Leu Ser Val Pro Ala					
260		265		270	
Phe Thr Leu Ile Ala Gly Asp Arg Ser Val Ser Gly Ser Ala Thr Gly					
275		280		285	
Thr Pro Tyr Glu Leu Arg Lys Leu Met Arg Phe Ala Ala Arg Ser Lys					
290		295		300	
Val Ala Pro Thr Thr Glu Leu Phe Pro Met Ser Lys Ile Asn Asp Ala					
305		310		315	
Ile Gln His Val Arg Asp Gly Lys Ala Arg Tyr Arg Val Val Leu Lys					
325		330		335	

Ala Asp Tyr

<210> 12

<211> 1020

<212> DNA

<213> 大肠杆菌

<400> 12

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 ttgcaggctcg gtcagcgtgt cgggattggc tggacggcgc gtagctgtgg tcaactgcgac 300
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 aatattgata tcgagtccgc cgggccgctg ttgtgcggcg gtatcacggt ctttaaacca 480
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 aatccggcga aagagcagga agtgctggcg atgggtgccg ataaagtggg gaatagccgc 660
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<210> 13

<211> 349

<212> PRT

<213> 大肠杆菌

<400> 13

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 Pro Met Asp Ile Thr Arg Arg Glu Pro Gly Pro Asn Asp Val Lys Ile
 20 25 30
 Glu Ile Ala Tyr Cys Gly Val Cys His Ser Asp Leu His Gln Val Arg
 35 40 45
 Ser Glu Trp Ala Gly Thr Val Tyr Pro Cys Val Pro Gly His Glu Ile
 50 55 60
 Val Gly Arg Val Val Ala Val Gly Asp Gln Val Glu Lys Tyr Ala Pro
 65 70 75 80
 Gly Asp Leu Val Gly Val Gly Cys Ile Val Asp Ser Cys Lys His Cys
 85 90 95
 Glu Glu Cys Glu Asp Gly Leu Glu Asn Tyr Cys Asp His Met Thr Gly
 100 105 110
 Thr Tyr Asn Ser Pro Thr Pro Asp Glu Pro Gly His Thr Leu Gly Gly
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 Tyr Ser Gln Gln Ile Val Val His Glu Arg Tyr Val Leu Arg Ile Arg
 130 135 140
 His Pro Gln Glu Gln Leu Ala Ala Val Ala Pro Leu Leu Cys Ala Gly

145	150	155	160
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Lys Val Gly Val Val Gly Ile Gly Gly Leu Gly His Met Gly Ile Lys			
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Leu Ala His Ala Met Gly Ala His Val Val Ala Phe Thr Thr Ser Glu			
	195	200	205
Ala Lys Arg Glu Ala Ala Lys Ala Leu Gly Ala Asp Glu Val Val Asn			
	210	215	220
Ser Arg Asn Ala Asp Glu Met Ala Ala His Leu Lys Ser Phe Asp Phe			
225	230	235	240
Ile Leu Asn Thr Val Ala Ala Pro His Asn Leu Asp Asp Phe Thr Thr			
	245	250	255
Leu Leu Lys Arg Asp Gly Thr Met Thr Leu Val Gly Ala Pro Ala Thr			
	260	265	270
Pro His Lys Ser Pro Glu Val Phe Asn Leu Ile Met Lys Arg Arg Ala			
	275	280	285
Ile Ala Gly Ser Met Ile Gly Gly Ile Pro Glu Thr Gln Glu Met Leu			
	290	295	300
Asp Phe Cys Ala Glu His Gly Ile Val Ala Asp Ile Glu Met Ile Arg			
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<210> 14

<211> 1050

<212> DNA

<213> 大肠杆菌

<400> 14

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<210> 15

<211> 891

<212> PRT

<213> 大肠杆菌

<400> 15

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			20					25					30		
Lys	Ile	Phe	Arg	Ala	Ala	Ala	Leu	Ala	Ala	Ala	Asp	Ala	Arg	Ile	Pro
		35					40				45				
Leu	Ala	Lys	Met	Ala	Val	Ala	Glu	Ser	Gly	Met	Gly	Ile	Val	Glu	Asp
		50					55				60				
Lys	Val	Ile	Lys	Asn	His	Phe	Ala	Ser	Glu	Tyr	Ile	Tyr	Asn	Ala	Tyr
65				70					75					80	
Lys	Asp	Glu	Lys	Thr	Cys	Gly	Val	Leu	Ser	Glu	Asp	Asp	Thr	Phe	Gly
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Thr	Ile	Thr	Ile	Ala	Glu	Pro	Ile	Gly	Ile	Ile	Cys	Gly	Ile	Val	Pro
			100					105					110		
Thr	Thr	Asn	Pro	Thr	Ser	Thr	Ala	Ile	Phe	Lys	Ser	Leu	Ile	Ser	Leu
			115					120				125			
Lys	Thr	Arg	Asn	Ala	Ile	Ile	Phe	Ser	Pro	His	Pro	Arg	Ala	Lys	Asp
			130					135				140			
Ala	Thr	Asn	Lys	Ala	Ala	Asp	Ile	Val	Leu	Gln	Ala	Ala	Ile	Ala	Ala
145				150					155					160	
Gly	Ala	Pro	Lys	Asp	Leu	Ile	Gly	Trp	Ile	Asp	Gln	Pro	Ser	Val	Glu
			165					170					175		
Leu	Ser	Asn	Ala	Leu	Met	His	His	Pro	Asp	Ile	Asn	Leu	Ile	Leu	Ala
			180					185				190			
Thr	Gly	Gly	Pro	Gly	Met	Val	Lys	Ala	Ala	Tyr	Ser	Ser	Gly	Lys	Pro

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210	215	220
Ala Asp Ile Lys Arg Ala Val Ala Ser Val Leu Met Ser Lys Thr Phe		
225	230	235
Asp Asn Gly Val Ile Cys Ala Ser Glu Gln Ser Val Val Val Val Asp		
245	250	255
Ser Val Tyr Asp Ala Val Arg Glu Arg Phe Ala Thr His Gly Gly Tyr		
260	265	270
Leu Leu Gln Gly Lys Glu Leu Lys Ala Val Gln Asp Val Ile Leu Lys		
275	280	285
Asn Gly Ala Leu Asn Ala Ala Ile Val Gly Gln Pro Ala Tyr Lys Ile		
290	295	300
Ala Glu Leu Ala Gly Phe Ser Val Pro Glu Asn Thr Lys Ile Leu Ile		
305	310	315
Gly Glu Val Thr Val Val Asp Glu Ser Glu Pro Phe Ala His Glu Lys		
325	330	335
Leu Ser Pro Thr Leu Ala Met Tyr Arg Ala Lys Asp Phe Glu Asp Ala		
340	345	350
Val Glu Lys Ala Glu Lys Leu Val Ala Met Gly Gly Ile Gly His Thr		
355	360	365
Ser Cys Leu Tyr Thr Asp Gln Asp Asn Gln Pro Ala Arg Val Ser Tyr		
370	375	380
Phe Gly Gln Lys Met Lys Thr Ala Arg Ile Leu Ile Asn Thr Pro Ala		
385	390	395
Ser Gln Gly Gly Ile Gly Asp Leu Tyr Asn Phe Lys Leu Ala Pro Ser		
405	410	415
Leu Thr Leu Gly Cys Gly Ser Trp Gly Gly Asn Ser Ile Ser Glu Asn		
420	425	430
Val Gly Pro Lys His Leu Ile Asn Lys Lys Thr Val Ala Lys Arg Ala		
435	440	445
Glu Asn Met Leu Trp His Lys Leu Pro Lys Ser Ile Tyr Phe Arg Arg		
450	455	460
Gly Ser Leu Pro Ile Ala Leu Asp Glu Val Ile Thr Asp Gly His Lys		
465	470	475
Arg Ala Leu Ile Val Thr Asp Arg Phe Leu Phe Asn Asn Gly Tyr Ala		
485	490	495
Asp Gln Ile Thr Ser Val Leu Lys Ala Ala Gly Val Glu Thr Glu Val		
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Arg	Lys	Arg	Ile	Tyr	Lys	Phe	Pro	Lys	Met	Gly	Val	Lys	Ala	Lys	Met
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Ile	Ala	Val	Thr	Thr	Thr	Ser	Gly	Thr	Gly	Ser	Glu	Val	Thr	Pro	Phe
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Tyr	Ala	Leu	Thr	Pro	Asp	Met	Ala	Ile	Val	Asp	Ala	Asn	Leu	Val	Met
625				630				635				640			
Asp	Met	Pro	Lys	Ser	Leu	Cys	Ala	Phe	Gly	Gly	Leu	Asp	Ala	Val	Thr
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675				680				685							
Ser	Tyr	His	Glu	Gly	Ser	Lys	Asn	Pro	Val	Ala	Arg	Glu	Arg	Val	His
690				695				700							
Ser	Ala	Ala	Thr	Ile	Ala	Gly	Ile	Ala	Phe	Ala	Asn	Ala	Phe	Leu	Gly
705				710				715				720			
Val	Cys	His	Ser	Met	Ala	His	Lys	Leu	Gly	Ser	Gln	Phe	His	Ile	Pro
725				730				735							
His	Gly	Leu	Ala	Asn	Ala	Leu	Leu	Ile	Cys	Asn	Val	Ile	Arg	Tyr	Asn
740				745				750							
Ala	Asn	Asp	Asn	Pro	Thr	Lys	Gln	Thr	Ala	Phe	Ser	Gln	Tyr	Asp	Arg
755				760				765							
Pro	Gln	Ala	Arg	Arg	Arg	Tyr	Ala	Glu	Ile	Ala	Asp	His	Leu	Gly	Leu
770				775				780							
Ser	Ala	Pro	Gly	Asp	Arg	Thr	Ala	Ala	Lys	Ile	Glu	Lys	Leu	Leu	Ala
785				790				795				800			
Trp	Leu	Glu	Thr	Leu	Lys	Ala	Glu	Leu	Gly	Ile	Pro	Lys	Ser	Ile	Arg
805				810				815							
Glu	Ala	Gly	Val	Gln	Glu	Ala	Asp	Phe	Leu	Ala	Asn	Val	Asp	Lys	Leu

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Ser Glu Asp Ala Phe Asp Asp Gln Cys Thr Gly Ala Asn Pro Arg Tyr		
835	840	845
Pro Leu Ile Ser Glu Leu Lys Gln Ile Leu Leu Asp Thr Tyr Tyr Gly		
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Arg Asp Tyr Val Glu Gly Glu Thr Ala Ala Lys Lys Glu Ala Ala Pro		
865	870	875
Ala Lys Ala Glu Lys Lys Ala Lys Lys Ser Ala		880
885	890	

<210> 16

<211> 2676

<212> DNA

<213> 大肠杆菌

<400> 16

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<210> 17

<211> 412

<212> PRT

<213> 大肠杆菌

<400> 17

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				20					25					30	
Thr	Ala	Thr	Ala	Ile	Cys	Gly	Ser	Asp	Leu	His	Leu	Tyr	Arg	Gly	Lys
				35					40					45	
Ile	Pro	Gln	Val	Lys	His	Gly	Asp	Ile	Phe	Gly	His	Glu	Phe	Met	Gly
				50					55					60	
Glu	Val	Val	Glu	Thr	Gly	Lys	Asp	Val	Lys	Asn	Leu	Gln	Lys	Gly	Asp
65					70					75					80
Arg	Val	Val	Ile	Pro	Phe	Val	Ile	Ala	Cys	Gly	Asp	Cys	Phe	Phe	Cys
					85					90					95
Arg	Leu	Gln	Gln	Tyr	Ala	Ala	Cys	Glu	Asn	Thr	Asn	Ala	Gly	Lys	Gly
					100					105					110

Ala Ala Leu Asn Lys Lys Gln Ile Pro Ala Pro Ala Ala Leu Phe Gly		
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130	135	140
Arg Val Pro Lys Gly Asn Val Gly Pro Phe Lys Val Pro Pro Leu Leu		
145	150	155
Ser Asp Asp Lys Ala Leu Phe Leu Ser Asp Ile Leu Pro Thr Ala Trp		
165	170	175
Gln Ala Ala Lys Asn Ala Gln Ile Gln Gln Gly Ser Ser Val Ala Val		
180	185	190
Tyr Gly Ala Gly Pro Val Gly Leu Leu Thr Ile Ala Cys Ala Arg Leu		
195	200	205
Leu Gly Ala Glu Gln Ile Phe Val Val Asp His His Pro Tyr Arg Leu		
210	215	220
His Phe Ala Ala Asp Arg Tyr Gly Ala Ile Pro Ile Asn Phe Asp Glu		
225	230	235
Asp Ser Asp Pro Ala Gln Ser Ile Ile Glu Gln Thr Ala Gly His Arg		
245	250	255
Gly Val Asp Ala Val Ile Asp Ala Val Gly Phe Glu Ala Lys Gly Ser		
260	265	270
Thr Thr Glu Thr Val Leu Thr Asn Leu Lys Leu Glu Gly Ser Ser Gly		
275	280	285
Lys Ala Leu Arg Gln Cys Ile Ala Ala Val Arg Arg Gly Gly Ile Val		
290	295	300
Ser Val Pro Gly Val Tyr Ala Gly Phe Ile His Gly Phe Leu Phe Gly		
305	310	315
Asp Ala Phe Asp Lys Gly Leu Ser Phe Lys Met Gly Gln Thr His Val		
325	330	335
His Ala Trp Leu Gly Glu Leu Leu Pro Leu Ile Glu Lys Gly Leu Leu		
340	345	350
Lys Pro Glu Glu Ile Val Thr His Tyr Met Pro Phe Glu Glu Ala Ala		
355	360	365
Arg Gly Tyr Glu Ile Phe Glu Lys Arg Glu Glu Glu Cys Arg Lys Val		
370	375	380
Ile Leu Val Pro Gly Ala Gln Ser Ala Glu Ala Ala Gln Lys Ala Val		
385	390	395
Ser Gly Leu Val Asn Ala Met Pro Gly Gly Thr Ile		
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<210> 18

<211> 1239

<212> DNA

<213> 大肠杆菌

<400> 18

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<210> 19

<211> 275

<212> PRT

<213> 大肠杆菌

<400> 19

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           20           25           30
Ala Ile Gln Lys Ala Leu Glu Val Gly Tyr Arg Ser Ile Asp Thr Ala
           35           40           45
Ala Ala Tyr Lys Asn Glu Glu Gly Val Gly Lys Ala Leu Lys Asn Ala
           50           55           60
Ser Val Asn Arg Glu Glu Leu Phe Ile Thr Thr Lys Leu Trp Asn Asp

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65	70	75	80
Asp His Lys Arg Pro Arg Glu Ala Leu Leu Asp Ser Leu Lys Lys Leu			
	85	90	95
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	100	105	110
Ile Asp His Tyr Val Glu Ala Trp Lys Gly Met Ile Glu Leu Gln Lys			
	115	120	125
Glu Gly Leu Ile Lys Ser Ile Gly Val Cys Asn Phe Gln Ile His His			
	130	135	140
Leu Gln Arg Leu Ile Asp Glu Thr Gly Val Thr Pro Val Ile Asn Gln			
145	150	155	160
Ile Glu Leu His Pro Leu Met Gln Gln Arg Gln Leu His Ala Trp Asn			
	165	170	175
Ala Thr His Lys Ile Gln Thr Glu Ser Trp Ser Pro Leu Ala Gln Gly			
	180	185	190
Gly Lys Gly Val Phe Asp Gln Lys Val Ile Arg Asp Leu Ala Asp Lys			
	195	200	205
Tyr Gly Lys Thr Pro Ala Gln Ile Val Ile Arg Trp His Leu Asp Ser			
	210	215	220
Gly Leu Val Val Ile Pro Lys Ser Val Thr Pro Ser Arg Ile Ala Glu			
225	230	235	240
Asn Phe Asp Val Trp Asp Phe Arg Leu Asp Lys Asp Glu Leu Gly Glu			
	245	250	255
Ile Ala Lys Leu Asp Gln Gly Lys Arg Leu Gly Pro Asp Pro Asp Gln			
	260	265	270
Phe Gly Gly			
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<210> 20

<211> 828

<212> DNA

<213> 大肠杆菌

<400> 20

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<210> 21

<211> 383

<212> PRT

<213> 大肠杆菌

<400> 21

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Asp	Ser	Leu	Thr	Asp	Ala	Met	Asn	Met	Met	Ala	Asp	Tyr	Gly	Phe	Thr
			20				25						30		
Arg	Thr	Leu	Ile	Val	Thr	Asp	Asn	Met	Leu	Thr	Lys	Leu	Gly	Met	Ala
			35				40						45		
Gly	Asp	Val	Gln	Lys	Ala	Leu	Glu	Glu	Arg	Asn	Ile	Phe	Ser	Val	Ile
		50				55				60					
Tyr	Asp	Gly	Thr	Gln	Pro	Asn	Pro	Thr	Thr	Glu	Asn	Val	Ala	Ala	Gly
65				70				75					80		
Leu	Lys	Leu	Leu	Lys	Glu	Asn	Asn	Cys	Asp	Ser	Val	Ile	Ser	Leu	Gly
				85				90					95		
Gly	Gly	Ser	Pro	His	Asp	Cys	Ala	Lys	Gly	Ile	Ala	Leu	Val	Ala	Ala
			100					105					110		
Asn	Gly	Gly	Asp	Ile	Arg	Asp	Tyr	Glu	Gly	Val	Asp	Arg	Ser	Ala	Lys
			115					120					125		
Pro	Gln	Leu	Pro	Met	Ile	Ala	Ile	Asn	Thr	Thr	Ala	Gly	Thr	Ala	Ser
			130					135					140		
Glu	Met	Thr	Arg	Phe	Cys	Ile	Ile	Thr	Asp	Glu	Ala	Arg	His	Ile	Lys
145				150						155				160	
Met	Ala	Ile	Val	Asp	Lys	His	Val	Thr	Pro	Leu	Leu	Ser	Val	Asn	Asp
				165						170				175	
Ser	Ser	Leu	Met	Ile	Gly	Met	Pro	Lys	Ser	Leu	Thr	Ala	Ala	Thr	Gly
			180					185					190		
Met	Asp	Ala	Leu	Thr	His	Ala	Ile	Glu	Ala	Tyr	Val	Ser	Ile	Ala	Ala
			195					200					205		
Thr	Pro	Ile	Thr	Asp	Ala	Cys	Ala	Leu	Lys	Ala	Val	Thr	Met	Ile	Ala

210	215	220
Glu Asn Leu Pro Leu Ala Val Glu Asp Gly Ser Asn Ala Lys Ala Arg		
225	230	235
Glu Ala Met Ala Tyr Ala Gln Phe Leu Ala Gly Met Ala Phe Asn Asn		240
	245	250
Ala Ser Leu Gly Tyr Val His Ala Met Ala His Gln Leu Gly Gly Phe		255
	260	265
Tyr Asn Leu Pro His Gly Val Cys Asn Ala Val Leu Leu Pro His Val		270
	275	280
Gln Val Phe Asn Ser Lys Val Ala Ala Ala Arg Leu Arg Asp Cys Ala		285
	290	295
Ala Ala Met Gly Val Asn Val Thr Gly Lys Asn Asp Ala Glu Gly Ala		300
305	310	315
Glu Ala Cys Ile Asn Ala Ile Arg Glu Leu Ala Lys Lys Val Asp Ile		320
	325	330
Pro Ala Gly Leu Arg Asp Leu Asn Val Lys Glu Glu Asp Phe Ala Val		335
	340	345
Leu Ala Thr Asn Ala Leu Lys Asp Ala Cys Gly Phe Thr Asn Pro Ile		350
	355	360
Gln Ala Thr His Glu Glu Ile Val Ala Ile Tyr Arg Ala Ala Met		365
	370	375
		380

<210> 22

<211> 1152

<212> DNA

<213> 大肠杆菌

<400> 22

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accatgattg ccgaaaacct gccgttagcc gttgaagatg gcagtaatgc gaaagcgctg 720
gaagcaatgg cttatgcca gttcctcgcc ggtatggcgt tcaataatgc ttctctgggt 780

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<210> 23

<211> 369

<212> PRT

<213> 大肠杆菌

<400> 23

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Ile	Val	Glu	Ile	Asp	Val	Ala	Pro	Pro	Lys	Lys	Gly	Glu	Val	Leu	Ile
				20					25					30	
Lys	Val	Thr	His	Thr	Gly	Val	Cys	His	Thr	Asp	Ala	Phe	Thr	Leu	Ser
				35					40					45	
Gly	Asp	Asp	Pro	Glu	Gly	Val	Phe	Pro	Val	Val	Leu	Gly	His	Glu	Gly
				50					55					60	
Ala	Gly	Val	Val	Val	Glu	Val	Gly	Glu	Gly	Val	Thr	Ser	Val	Lys	Pro
65					70					75					80
Gly	Asp	His	Val	Ile	Pro	Leu	Tyr	Thr	Ala	Glu	Cys	Gly	Glu	Cys	Glu
				85					90					95	
Phe	Cys	Arg	Ser	Gly	Lys	Thr	Asn	Leu	Cys	Val	Ala	Val	Arg	Glu	Thr
				100					105					110	
Gln	Gly	Lys	Gly	Leu	Met	Pro	Asp	Gly	Thr	Thr	Arg	Phe	Ser	Tyr	Asn
				115					120					125	
Gly	Gln	Pro	Leu	Tyr	His	Tyr	Met	Gly	Cys	Ser	Thr	Phe	Ser	Glu	Tyr
				130					135					140	
Thr	Val	Val	Ala	Glu	Val	Ser	Leu	Ala	Lys	Ile	Asn	Pro	Glu	Ala	Asn
145					150					155					160
His	Glu	His	Val	Cys	Leu	Leu	Gly	Cys	Gly	Val	Thr	Thr	Gly	Ile	Gly
				165						170				175	
Ala	Val	His	Asn	Thr	Ala	Lys	Val	Gln	Pro	Gly	Asp	Ser	Val	Ala	Val
				180					185					190	
Phe	Gly	Leu	Gly	Ala	Ile	Gly	Leu	Ala	Val	Val	Gln	Gly	Ala	Arg	Gln
				195					200					205	
Ala	Lys	Ala	Gly	Arg	Ile	Ile	Ala	Ile	Asp	Thr	Asn	Pro	Lys	Lys	Phe

210	215	220
Asp Leu Ala Arg Arg Phe Gly Ala Thr Asp Cys Ile Asn Pro Asn Asp		
225	230	235
Tyr Asp Lys Pro Ile Lys Asp Val Leu Leu Asp Ile Asn Lys Trp Gly		240
	245	250
Ile Asp His Thr Phe Glu Cys Ile Gly Asn Val Asn Val Met Arg Ala		255
	260	265
Ala Leu Glu Ser Ala His Arg Gly Trp Gly Gln Ser Val Ile Ile Gly		270
	275	280
Val Ala Gly Ala Gly Gln Glu Ile Ser Thr Arg Pro Phe Gln Leu Val		285
	290	295
Thr Gly Arg Val Trp Lys Gly Ser Ala Phe Gly Gly Val Lys Gly Arg		300
305	310	315
Ser Gln Leu Pro Gly Met Val Glu Asp Ala Met Lys Gly Asp Ile Asp		320
	325	330
Leu Glu Pro Phe Val Thr His Thr Met Ser Leu Asp Glu Ile Asn Asp		335
	340	345
Ala Phe Asp Leu Met His Glu Gly Lys Ser Ile Arg Thr Val Ile Arg		350
	355	360
		365

Tyr

<210> 24

<211> 1110

<212> DNA

<213> 大肠杆菌

<400> 24

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<210> 25

<211> 267

<212> PRT

<213> 大肠杆菌

<400> 25

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Val	Val	Ile	Ser	Ser	Val	Lys	Thr	Ala	Leu	Glu	Leu	Gly	Tyr	Arg	Ala
				20				25					30		
Ile	Asp	Thr	Ala	Gln	Ile	Tyr	Asp	Asn	Glu	Ala	Ala	Val	Gly	Gln	Ala
				35				40					45		
Ile	Ala	Glu	Ser	Gly	Val	Pro	Arg	His	Glu	Leu	Tyr	Ile	Thr	Thr	Lys
				50				55				60			
Ile	Trp	Ile	Glu	Asn	Leu	Ser	Lys	Asp	Lys	Leu	Ile	Pro	Ser	Leu	Lys
65				70				75				80			
Glu	Ser	Leu	Gln	Lys	Leu	Arg	Thr	Asp	Tyr	Val	Asp	Leu	Thr	Leu	Ile
				85				90				95			
His	Trp	Pro	Ser	Pro	Asn	Asp	Glu	Val	Ser	Val	Glu	Glu	Phe	Met	Gln
				100				105				110			
Glu	Leu	Leu	Glu	Ala	Lys	Lys	Glu	Gly	Leu	Thr	Arg	Glu	Ile	Gly	Ile
				115				120				125			
Ser	Asn	Phe	Thr	Ile	Pro	Leu	Met	Glu	Lys	Ala	Ile	Ala	Ala	Val	Gly
				130				135				140			
Ala	Glu	Asn	Ile	Ala	Thr	Asn	Gln	Ile	Glu	Leu	Ser	Pro	Tyr	Leu	Gln
145				150				155				160			
Asn	Arg	Lys	Val	Val	Ala	Trp	Ala	Lys	Gln	His	Gly	Ile	His	Ile	Thr
				165				170				175			
Ser	Tyr	Met	Thr	Leu	Ala	Tyr	Gly	Lys	Ala	Leu	Lys	Asp	Glu	Val	Ile
				180				185				190			
Ala	Arg	Ile	Ala	Ala	Lys	His	Asn	Ala	Thr	Pro	Ala	Gln	Val	Ile	Leu
				195				200				205			
Ala	Trp	Ala	Met	Gly	Glu	Gly	Tyr	Ser	Val	Ile	Pro	Ser	Ser	Thr	Lys
				210				215				220			
Arg	Lys	Asn	Leu	Glu	Ser	Asn	Leu	Lys	Ala	Gln	Asn	Leu	Gln	Leu	Asp

225	230	235	240
Ala Glu Asp Lys Lys Ala Ile Ala Ala Leu Asp Cys Asn Asp Arg Leu			
	245	250	255
Val Ser Pro Glu Gly Leu Ala Pro Glu Trp Asp			
260	265		
<210> 26			
<211> 804			
<212> DNA			
<213> 大肠杆菌			
<400> 26			
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<210> 27			
<211> 294			
<212> PRT			
<213> 大肠杆菌			
<400> 27			
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20 25 30			
Val Pro Asp Cys Gly Glu Lys Thr Tyr Val Gly Ser Gly Arg Leu Lys			
35 40 45			
Asp Arg Lys Ala Leu Val Thr Gly Gly Asp Ser Gly Ile Gly Arg Ala			
50 55 60			
Ala Ala Ile Ala Tyr Ala Arg Glu Gly Ala Asp Val Ala Ile Ser Tyr			
65 70 75 80			

Leu Pro Val Glu Glu Glu Asp Ala Gln Asp Val Lys Lys Ile Ile Glu
 85 90 95
 Glu Cys Gly Arg Lys Ala Val Leu Leu Pro Gly Asp Leu Ser Asp Glu
 100 105 110
 Lys Phe Ala Arg Ser Leu Val His Glu Ala His Lys Ala Leu Gly Gly
 115 120 125
 Leu Asp Ile Met Ala Leu Val Ala Gly Lys Gln Val Ala Ile Pro Asp
 130 135 140
 Ile Ala Asp Leu Thr Ser Glu Gln Phe Gln Lys Thr Phe Ala Ile Asn
 145 150 155 160
 Val Phe Ala Leu Phe Trp Leu Thr Gln Glu Ala Ile Pro Leu Leu Pro
 165 170 175
 Lys Gly Ala Ser Ile Ile Thr Thr Ser Ser Ile Gln Ala Tyr Gln Pro
 180 185 190
 Ser Pro His Leu Leu Asp Tyr Ala Ala Thr Lys Ala Ala Ile Leu Asn
 195 200 205
 Tyr Ser Arg Gly Leu Ala Lys Gln Val Ala Glu Lys Gly Ile Arg Val
 210 215 220
 Asn Ile Val Ala Pro Gly Pro Ile Trp Thr Ala Leu Gln Ile Ser Gly
 225 230 235 240
 Gly Gln Thr Gln Asp Lys Ile Pro Gln Phe Gly Gln Gln Thr Pro Met
 245 250 255
 Lys Arg Ala Gly Gln Pro Ala Glu Leu Ala Pro Val Tyr Val Tyr Leu
 260 265 270
 Ala Ser Gln Glu Ser Ser Tyr Val Thr Ala Glu Val His Gly Val Cys
 275 280 285
 Gly Gly Glu His Leu Gly
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<210> 28

<211> 885

<212> DNA

<213> 大肠杆菌

<400> 28

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<210> 29

<211> 326

<212> PRT

<213> 大肠杆菌

<400> 29

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			20						25					30	
Leu	Asp	Arg	Gln	Ile	Cys	Ile	Asp	Thr	Ile	Leu	Glu	Ala	His	Arg	Cys
			35						40					45	
Gly	Ile	Asn	Leu	Ile	Asp	Thr	Ala	Pro	Gly	Tyr	Asn	Phe	Gly	Asn	Ser
			50						55					60	
Glu	Val	Ile	Val	Gly	Gln	Ala	Leu	Lys	Lys	Leu	Pro	Arg	Glu	Gln	Val
65					70					75					80
Val	Val	Glu	Thr	Lys	Cys	Gly	Ile	Val	Trp	Glu	Arg	Lys	Gly	Ser	Leu
					85					90					95
Phe	Asn	Lys	Val	Gly	Asp	Arg	Gln	Leu	Tyr	Lys	Asn	Leu	Ser	Pro	Glu
					100					105					110
Ser	Ile	Arg	Glu	Glu	Val	Glu	Ala	Ser	Leu	Gln	Arg	Leu	Gly	Ile	Asp
					115					120					125
Tyr	Ile	Asp	Ile	Tyr	Met	Thr	His	Trp	Gln	Ser	Val	Pro	Pro	Phe	Phe
					130					135					140
Thr	Pro	Ile	Ala	Glu	Thr	Val	Ala	Val	Leu	Asn	Glu	Leu	Lys	Ala	Glu
145						150					155				160
Gly	Lys	Ile	Arg	Ala	Ile	Gly	Ala	Ala	Asn	Val	Asp	Ala	Asp	His	Ile
						165									175
Arg	Glu	Tyr	Leu	Gln	Tyr	Gly	Glu	Leu	Asp	Ile	Ile	Gln	Ala	Lys	Tyr
						180									190
Ser	Ile	Leu	Asp	Arg	Ala	Met	Glu	Asn	Glu	Leu	Leu	Pro	Leu	Cys	Arg

195	200	205
Asp Asn Gly Ile Val Val Gln Val Tyr Ser Pro Leu Glu Gln Gly Leu		
210	215	220
Leu Thr Gly Thr Ile Thr Arg Asp Tyr Val Pro Gly Gly Ala Arg Ala		
225	230	235
Asn Lys Val Trp Phe Gln Arg Glu Asn Met Leu Lys Val Ile Asp Met		
245	250	255
Leu Glu Gln Trp Gln Pro Leu Cys Ala Arg Tyr Gln Cys Thr Ile Pro		
260	265	270
Thr Leu Ala Leu Ala Trp Ile Leu Lys Gln Ser Asp Leu Ile Ser Ile		
275	280	285
Leu Ser Gly Ala Thr Ala Pro Glu Gln Val Arg Glu Asn Val Ala Ala		
290	295	300
Leu Asn Ile Asn Leu Ser Asp Ala Asp Ala Thr Leu Met Arg Glu Met		
305	310	315
Ala Glu Ala Leu Glu Arg		
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<210> 30

<211> 981

<212> DNA

<213> 大肠杆菌

<400> 30

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<210> 31

<211> 367

<212> PRT

<213> 大肠杆菌

<400> 31

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           20           25           30
Leu Val Val Gly Asp Lys Phe Val Leu Gly Phe Ala Gln Ser Thr Val
           35           40           45
Glu Lys Ser Phe Lys Asp Ala Gly Leu Val Val Glu Ile Ala Pro Phe
           50           55           60
Gly Gly Glu Cys Ser Gln Asn Glu Ile Asp Arg Leu Arg Gly Ile Ala
65           70           75           80
Glu Thr Ala Gln Cys Gly Ala Ile Leu Gly Ile Gly Gly Gly Lys Thr
           85           90           95
Leu Asp Thr Ala Lys Ala Leu Ala His Phe Met Gly Val Pro Val Ala
           100          105          110
Ile Ala Pro Thr Ile Ala Ser Thr Asp Ala Pro Cys Ser Ala Leu Ser
           115          120          125
Val Ile Tyr Thr Asp Glu Gly Glu Phe Asp Arg Tyr Leu Leu Leu Pro
           130          135          140
Asn Asn Pro Asn Met Val Ile Val Asp Thr Lys Ile Val Ala Gly Ala
145          150          155          160
Pro Ala Arg Leu Leu Ala Ala Gly Ile Gly Asp Ala Leu Ala Thr Trp
           165          170          175
Phe Glu Ala Arg Ala Cys Ser Arg Ser Gly Ala Thr Thr Met Ala Gly
           180          185          190
Gly Lys Cys Thr Gln Ala Ala Leu Ala Leu Ala Glu Leu Cys Tyr Asn
           195          200          205
Thr Leu Leu Glu Glu Gly Glu Lys Ala Met Leu Ala Ala Glu Gln His
           210          215          220
Val Val Thr Pro Ala Leu Glu Arg Val Ile Glu Ala Asn Thr Tyr Leu
225          230          235          240
Ser Gly Val Gly Phe Glu Ser Gly Gly Leu Ala Ala Ala His Ala Val
           245          250          255
His Asn Gly Leu Thr Ala Ile Pro Asp Ala His His Tyr Tyr His Gly
           260          265          270

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Glu Lys Val Ala Phe Gly Thr Leu Thr Gln Leu Val Leu Glu Asn Ala		
275	280	285
Pro Val Glu Glu Ile Glu Thr Val Ala Ala Leu Ser His Ala Val Gly		
290	295	300
Leu Pro Ile Thr Leu Ala Gln Leu Asp Ile Lys Glu Asp Val Pro Ala		
305	310	315
Lys Met Arg Ile Val Ala Glu Ala Ala Cys Ala Glu Gly Glu Thr Ile		
	325	330
His Asn Met Pro Gly Gly Ala Thr Pro Asp Gln Val Tyr Ala Ala Leu		
	340	345
Leu Val Ala Asp Gln Tyr Gly Gln Arg Phe Leu Gln Glu Trp Glu		
	355	360

<210> 32

<211> 1104

<212> DNA

<213> 大肠杆菌

<400> 32

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gcaactggctg aactgtgcta caacaccctg ctggaagaag gcgaaaaagc gatgcttgct 660
gccgaacagc atgtagtgac tccggcgctg gagcgcgtga ttgaagcgaa cacctatttg 720
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catgcggtag gtttgccaat aactctcgct caactggata ttaaagaaga tgtcccggcg 960
aaaatgcgaa ttgtggcaga agcggcatgt gcagaagggtg aaaccatcca caacatgcct 1020
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cgtttctctgc aagagtggga ataa 1104

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<210> 33

<211> 253

<212> PRT

<213> 大肠杆菌

<400> 33

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Met Ala Gln Val Ala Ile Ile Thr Ala Ser Asp Ser Gly Ile Gly Lys
1           5           10           15
Glu Cys Ala Leu Leu Leu Ala Gln Gln Gly Phe Asp Ile Gly Ile Thr
          20           25           30
Trp His Ser Asp Glu Glu Gly Ala Lys Asp Thr Ala Arg Glu Val Val
          35           40           45
Ser His Gly Val Arg Ala Glu Ile Val Gln Leu Asp Leu Gly Asn Leu
          50           55           60
Pro Glu Gly Ala Leu Ala Leu Glu Lys Leu Ile Gln Arg Leu Gly Arg
65           70           75           80
Ile Asp Val Leu Val Asn Asn Ala Gly Ala Met Thr Lys Ala Pro Phe
          85           90           95
Leu Asp Met Ala Phe Asp Glu Trp Arg Lys Ile Phe Thr Val Asp Val
          100          105          110
Asp Gly Ala Phe Leu Cys Ser Gln Ile Ala Ala Arg Gln Met Val Lys
          115          120          125
Gln Gly Gln Gly Gly Arg Ile Ile Asn Ile Thr Ser Val His Glu His
          130          135          140
Thr Pro Leu Pro Asp Ala Ser Ala Tyr Thr Ala Ala Lys His Ala Leu
145          150          155          160
Gly Gly Leu Thr Lys Ala Met Ala Leu Glu Leu Val Arg His Lys Ile
          165          170          175
Leu Val Asn Ala Val Ala Pro Gly Ala Ile Ala Thr Pro Met Asn Gly
          180          185          190
Met Asp Asp Ser Asp Val Lys Pro Asp Ala Glu Pro Ser Ile Pro Leu
          195          200          205
Arg Arg Phe Gly Ala Thr His Glu Ile Ala Ser Leu Val Val Trp Leu
          210          215          220
Cys Ser Glu Gly Ala Asn Tyr Thr Thr Gly Gln Ser Leu Ile Val Asp
225          230          235          240
Gly Gly Phe Met Leu Ala Asn Pro Gln Phe Asn Pro Glu
          245          250

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<210> 34

<211> 762

<212> DNA

<213> 大肠杆菌

<400> 34

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 aaagataccg cgcgtgaggt agttagccac ggcgtacgtg cggagatcgt gcagctggat 180
 ctcggcaatc taccagaagg ggcactggcg ctggagaaac tcattcaacg gctggggcgc 240
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 gtacatgaac atacgccgct gccggatgcc agcgcctaca cagccgctaa acatgcgctc 480
 ggtgggttaa ccaaagcgat ggcgctggag ctggtcaggc ataagatttt ggtgaacgca 540
 gtcgcgcctg gggcgatcgc cagccaatg aatggcatgg atgacagcga cgtgaagccc 600
 gacgcggagc cttcgattcc cttgcggcgt tttggcgcaa cgcagatgat tgccagcctg 660
 gtggtgtggc tttgttcgga gggcgcaaat tacaccaccg ggcagtcgtt gatagtggat 720
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<210> 35

<211> 284

<212> PRT

<213> 大肠杆菌

<400> 35

Met Gln Gln Lys Met Ile Gln Phe Ser Gly Asp Val Ser Leu Pro Ala
 1 5 10 15
 Val Gly Gln Gly Thr Trp Tyr Met Gly Glu Asp Ala Ser Gln Arg Lys
 20 25 30
 Thr Glu Val Ala Ala Leu Arg Ala Gly Ile Glu Leu Gly Leu Thr Leu
 35 40 45
 Ile Asp Thr Ala Glu Met Tyr Ala Asp Gly Gly Ala Glu Lys Val Val
 50 55 60
 Gly Glu Ala Leu Thr Gly Leu Arg Glu Lys Val Phe Leu Val Ser Lys
 65 70 75 80
 Val Tyr Pro Trp Asn Ala Gly Gly Gln Lys Ala Ile Asn Ala Cys Glu
 85 90 95
 Ala Ser Leu Arg Arg Leu Asn Thr Asp Tyr Leu Asp Leu Tyr Leu Leu
 100 105 110
 His Trp Ser Gly Ser Phe Ala Phe Glu Glu Thr Val Ala Ala Met Glu
 115 120 125
 Lys Leu Ile Ala Gln Gly Lys Ile Arg Arg Trp Gly Val Ser Asn Leu
 130 135 140
 Asp Tyr Ala Asp Met Gln Glu Leu Trp Gln Leu Pro Gly Gly Asn Gln
 145 150 155 160
 Cys Ala Thr Asn Gln Val Leu Tyr His Leu Gly Ser Arg Gly Ile Glu

	165		170		175
Tyr Asp Leu Leu Pro Trp Cys Gln Gln Gln Gln Met Pro Val Met Ala					
	180		185		190
Tyr Ser Pro Leu Ala Gln Ala Gly Arg Leu Arg Asn Gly Leu Leu Lys					
	195		200		205
Asn Ala Val Val Asn Glu Ile Ala His Ala His Asn Ile Ser Ala Ala					
	210		215		220
Gln Val Leu Leu Ala Trp Val Ile Ser His Gln Gly Val Met Ala Ile					
225		230		235	240
Pro Lys Ala Ala Thr Ile Ala His Val Gln Gln Asn Ala Ala Val Leu					
	245		250		255
Glu Val Glu Leu Ser Ser Ala Glu Leu Ala Met Leu Asp Lys Ala Tyr					
	260		265		270
Pro Ala Pro Lys Gly Lys Thr Ala Leu Asp Met Val					
	275		280		

<210> 36

<211> 855

<212> DNA

<213> 大肠杆菌

<400> 36

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 ggcatgtaac tcggtttaac cctcattgat accgccgaaa tgtatgccga tggcgggtgcc 180
 gaaaagggtg ttggggaagc attaacgggt ctgcgagaga aggtctttct cgtctctaaa 240
 gtctatccgt ggaatgctgg cgggcaaaaa gcgataaatg catgcgaagc cagtttacgc 300
 cgtctcaata ctgattatct cgatctttac ttattacact ggtctggcag tttcgctttt 360
 gaagagactg tcgcagcgat ggaaaaattg atcgcccagg gaaaaatccg ccgctggggc 420
 gtttctaacc ttgattatgc tgatatgcag gaactctggc agctgccggg gggaaatcag 480
 tgtgccacta atcagggtgt ttaccatctc ggttcacgag gaattgagta cgatctactc 540
 ccctgggtgcc agcaacagca gatgccggtg atggcttaca gtccgttagc ccaggccggg 600
 cggttgcgca atggactgtt aaaaaacgcg gtagtcaacg aaattgcaca tgctcacaat 660
 atcagcgcgg cacaagtatt gttggcgtgg gtgatcagtc atcagggtgt gatggcgatt 720
 ccaaaagcgg ccacgattgc ccatgtccaa caaatgcgg ctgtgcttga ggtcgaactt 780
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<210> 37

<211> 348

<212> PRT

<213> 酿酒酵母

<400> 37

Met	Ser	Ile	Pro	Glu	Thr	Gln	Lys	Gly	Val	Ile	Phe	Tyr	Glu	Ser	His
1				5					10					15	
Gly	Lys	Leu	Glu	Tyr	Lys	Asp	Ile	Pro	Val	Pro	Lys	Pro	Lys	Ala	Asn
			20					25					30		
Glu	Leu	Leu	Ile	Asn	Val	Lys	Tyr	Ser	Gly	Val	Cys	His	Thr	Asp	Leu
		35					40					45			
His	Ala	Trp	His	Gly	Asp	Trp	Pro	Leu	Pro	Val	Lys	Leu	Pro	Leu	Val
	50					55					60				
Gly	Gly	His	Glu	Gly	Ala	Gly	Val	Val	Val	Gly	Met	Gly	Glu	Asn	Val
65					70				75					80	
Lys	Gly	Trp	Lys	Ile	Gly	Asp	Tyr	Ala	Gly	Ile	Lys	Trp	Leu	Asn	Gly
				85				90					95		
Ser	Cys	Met	Ala	Cys	Glu	Tyr	Cys	Glu	Leu	Gly	Asn	Glu	Ser	Asn	Cys
			100					105					110		
Pro	His	Ala	Asp	Leu	Ser	Gly	Tyr	Thr	His	Asp	Gly	Ser	Phe	Gln	Gln
		115					120					125			
Tyr	Ala	Thr	Ala	Asp	Ala	Val	Gln	Ala	Ala	His	Ile	Pro	Gln	Gly	Thr
		130				135					140				
Asp	Leu	Ala	Gln	Val	Ala	Pro	Ile	Leu	Cys	Ala	Gly	Ile	Thr	Val	Tyr
145				150					155					160	
Lys	Ala	Leu	Lys	Ser	Ala	Asn	Leu	Met	Ala	Gly	His	Trp	Val	Ala	Ile
				165				170						175	
Ser	Gly	Ala	Ala	Gly	Gly	Leu	Gly	Ser	Leu	Ala	Val	Gln	Tyr	Ala	Lys
			180				185						190		
Ala	Met	Gly	Tyr	Arg	Val	Leu	Gly	Ile	Asp	Gly	Gly	Glu	Gly	Lys	Glu
		195				200						205			
Glu	Leu	Phe	Arg	Ser	Ile	Gly	Gly	Glu	Val	Phe	Ile	Asp	Phe	Thr	Lys
		210				215					220				
Glu	Lys	Asp	Ile	Val	Gly	Ala	Val	Leu	Lys	Ala	Thr	Asp	Gly	Gly	Ala
225				230					235					240	
His	Gly	Val	Ile	Asn	Val	Ser	Val	Ser	Glu	Ala	Ala	Ile	Glu	Ala	Ser
				245				250						255	
Thr	Arg	Tyr	Val	Arg	Ala	Asn	Gly	Thr	Thr	Val	Leu	Val	Gly	Met	Pro
		260					265						270		
Ala	Gly	Ala	Lys	Cys	Cys	Ser	Asp	Val	Phe	Asn	Gln	Val	Val	Lys	Ser
		275				280					285				
Ile	Ser	Ile	Val	Gly	Ser	Tyr	Val	Gly	Asn	Arg	Ala	Asp	Thr	Arg	Glu
	290					295					300				

Ala Leu Asp Phe Phe Ala Arg Gly Leu Val Lys Ser Pro Ile Lys Val
 305 310 315 320
 Val Gly Leu Ser Thr Leu Pro Glu Ile Tyr Glu Lys Met Glu Lys Gly
 325 330 335
 Gln Ile Val Gly Arg Tyr Val Val Asp Thr Ser Lys
 340 345

<210> 38

<211> 1047

<212> DNA

<213> 酿酒酵母

<400> 38

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 tctggtgtct gtcacactga cttgcacgct tggcacggtg actggccatt gccagttaag 180
 ctaccattag tcggtggtca cgaaggtgcc ggtgtcgttg tcggcatggg tgaaaacgtt 240
 aagggctgga agatcggtga ctacgccggt atcaaagtgt tgaacggttc ttgtatggcc 300
 tgtgaatact gtgaattggg taacgaatcc aactgtcctc acgtgactt gtctggttac 360
 acccacgacg gttctttcca acaatacgtc accgctgacg ctgttcaagc cgctcacatt 420
 cctcaaggta ccgacttggc ccaagtcgcc cccatcttgt gtgctggtat caccgtctac 480
 aaggctttga agtctgctaa cttgatggcc ggtcactggg ttgctatctc cgggtgctgct 540
 ggtggtctag gttctttggc tgttcaatac gccaaaggta tgggttacag agtcttgggt 600
 attgacggtg gtgaaggtaa ggaagaatta ttcagatcca tcggtggtga agtcttcatt 660
 gacttcacta aggaaaagga cattgtcggg gctgttctaa aggccactga cgggtggtgct 720
 cacggtgtca tcaacgtttc cgtttccgaa gccgctattg aagcttctac cagatacgtt 780
 agagctaacg gtaccaccgt tttggtcggg atgccagctg gtgccaagtg ttgttctgat 840
 gtcttcaacc aagtcgtcaa gtccatctct attgttggtt cttacgtcgg taacagagct 900
 gacaccagag aagctttgga cttcttcgcc agaggtttgg tcaagtctcc aatcaaggtt 960
 gtcggcttgt ctaccttgcc agaaatttac gaaaagatgg aaaagggtca aatcgttggt 1020
 agatacgttg ttgacacttc taaataa 1047

<210> 39

<211> 348

<212> PRT

<213> 酿酒酵母

<400> 39

Met Ser Ile Pro Glu Thr Gln Lys Ala Ile Ile Phe Tyr Glu Ser Asn
 1 5 10 15
 Gly Lys Leu Glu His Lys Asp Ile Pro Val Pro Lys Pro Lys Pro Asn
 20 25 30
 Glu Leu Leu Ile Asn Val Lys Tyr Ser Gly Val Cys His Thr Asp Leu

35	40	45
His Ala Trp His Gly Asp Trp Pro Leu Pro Thr Lys Leu Pro Leu Val		
50	55	60
Gly Gly His Glu Gly Ala Gly Val Val Val Gly Met Gly Glu Asn Val		
65	70	75
Lys Gly Trp Lys Ile Gly Asp Tyr Ala Gly Ile Lys Trp Leu Asn Gly		
85	90	95
Ser Cys Met Ala Cys Glu Tyr Cys Glu Leu Gly Asn Glu Ser Asn Cys		
100	105	110
Pro His Ala Asp Leu Ser Gly Tyr Thr His Asp Gly Ser Phe Gln Glu		
115	120	125
Tyr Ala Thr Ala Asp Ala Val Gln Ala Ala His Ile Pro Gln Gly Thr		
130	135	140
Asp Leu Ala Glu Val Ala Pro Ile Leu Cys Ala Gly Ile Thr Val Tyr		
145	150	155
Lys Ala Leu Lys Ser Ala Asn Leu Arg Ala Gly His Trp Ala Ala Ile		
165	170	175
Ser Gly Ala Ala Gly Gly Leu Gly Ser Leu Ala Val Gln Tyr Ala Lys		
180	185	190
Ala Met Gly Tyr Arg Val Leu Gly Ile Asp Gly Gly Pro Gly Lys Glu		
195	200	205
Glu Leu Phe Thr Ser Leu Gly Gly Glu Val Phe Ile Asp Phe Thr Lys		
210	215	220
Glu Lys Asp Ile Val Ser Ala Val Val Lys Ala Thr Asn Gly Gly Ala		
225	230	235
His Gly Ile Ile Asn Val Ser Val Ser Glu Ala Ala Ile Glu Ala Ser		
245	250	255
Thr Arg Tyr Cys Arg Ala Asn Gly Thr Val Val Leu Val Gly Leu Pro		
260	265	270
Ala Gly Ala Lys Cys Ser Ser Asp Val Phe Asn His Val Val Lys Ser		
275	280	285
Ile Ser Ile Val Gly Ser Tyr Val Gly Asn Arg Ala Asp Thr Arg Glu		
290	295	300
Ala Leu Asp Phe Phe Ala Arg Gly Leu Val Lys Ser Pro Ile Lys Val		
305	310	315
Val Gly Leu Ser Ser Leu Pro Glu Ile Tyr Glu Lys Met Glu Lys Gly		
325	330	335
Gln Ile Ala Gly Arg Tyr Val Val Asp Thr Ser Lys		
340	345	

<210> 40

<211> 1047

<212> DNA

<213> 酿酒酵母

<400> 40

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tctggtgtct gccacaccga tttgcacgct tggcatgggt actggccatt gccaaactaag 180
ttaccattag ttggtgggtca cgaaggtgcc ggtgtcggtt tcggcatggg tgaaaacgtt 240
aagggctgga agatcggtga ctacgccggt atcaaatggt tgaacggttc ttgtatggcc 300
tgtgaatact gtgaattggg taacgaatcc aactgtcttc acgtgactt gtctggttac 360
accacacgac gttctttcca agaatacgt accgctgacg ctgttcaagc cgctcacatt 420
cctcaaggta ctgacttggc tgaagtcgcg ccaatcttgt gtgctggtat caccgtatac 480
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attgatgggt gtccaggaaa ggaagaattg tttacctcgc tcggtggtga agtattcatc 660
gacttcacca aagagaagga cattgttagc gcagtcgtta aggctaccaa cggcggtgcc 720
cacggtatca tcaatgtttc cgtttccgaa gccgctatcg aagcttctac cagatactgt 780
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gtcttcaacc acgttgtcaa gtctatctcc attgtcggct cttacgtggg gaacagagct 900
gataccagag aagccttaga tttctttgcc agaggtctag tcaagtctcc aataaaggta 960
gttggcttat ccagtttacc agaaatttac gaaaagatgg agaaggcca aattgctggt 1020
agatacgttg ttgacacttc taaataa 1047

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<210> 41

<211> 375

<212> PRT

<213> 酿酒酵母

<400> 41

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Met Leu Arg Thr Ser Thr Leu Phe Thr Arg Arg Val Gln Pro Ser Leu
1           5           10           15
Phe Ser Arg Asn Ile Leu Arg Leu Gln Ser Thr Ala Ala Ile Pro Lys
          20           25           30
Thr Gln Lys Gly Val Ile Phe Tyr Glu Asn Lys Gly Lys Leu His Tyr
          35           40           45
Lys Asp Ile Pro Val Pro Glu Pro Lys Pro Asn Glu Ile Leu Ile Asn
          50           55           60
Val Lys Tyr Ser Gly Val Cys His Thr Asp Leu His Ala Trp His Gly
65           70           75           80
Asp Trp Pro Leu Pro Val Lys Leu Pro Leu Val Gly Gly His Glu Gly

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				85					90					95			
Ala	Gly	Val	Val	Val	Lys	Leu	Gly	Ser	Asn	Val	Lys	Gly	Trp	Lys	Val		
				100					105					110			
Gly	Asp	Leu	Ala	Gly	Ile	Lys	Trp	Leu	Asn	Gly	Ser	Cys	Met	Thr	Cys		
				115					120					125			
Glu	Phe	Cys	Glu	Ser	Gly	His	Glu	Ser	Asn	Cys	Pro	Asp	Ala	Asp	Leu		
				130					135					140			
Ser	Gly	Tyr	Thr	His	Asp	Gly	Ser	Phe	Gln	Gln	Phe	Ala	Thr	Ala	Asp		
145					150					155				160			
Ala	Ile	Gln	Ala	Ala	Lys	Ile	Gln	Gln	Gly	Thr	Asp	Leu	Ala	Glu	Val		
					165					170				175			
Ala	Pro	Ile	Leu	Cys	Ala	Gly	Val	Thr	Val	Tyr	Lys	Ala	Leu	Lys	Glu		
				180					185					190			
Ala	Asp	Leu	Lys	Ala	Gly	Asp	Trp	Val	Ala	Ile	Ser	Gly	Ala	Ala	Gly		
				195					200					205			
Gly	Leu	Gly	Ser	Leu	Ala	Val	Gln	Tyr	Ala	Thr	Ala	Met	Gly	Tyr	Arg		
				210					215					220			
Val	Leu	Gly	Ile	Asp	Ala	Gly	Glu	Glu	Lys	Glu	Lys	Leu	Phe	Lys	Lys		
225					230					235				240			
Leu	Gly	Gly	Glu	Val	Phe	Ile	Asp	Phe	Thr	Lys	Thr	Lys	Asn	Met	Val		
				245					250					255			
Ser	Asp	Ile	Gln	Glu	Ala	Thr	Lys	Gly	Gly	Pro	His	Gly	Val	Ile	Asn		
				260					265					270			
Val	Ser	Val	Ser	Glu	Ala	Ala	Ile	Ser	Leu	Ser	Thr	Glu	Tyr	Val	Arg		
				275					280					285			
Pro	Cys	Gly	Thr	Val	Val	Leu	Val	Gly	Leu	Pro	Ala	Asn	Ala	Tyr	Val		
				290					295					300			
Lys	Ser	Glu	Val	Phe	Ser	His	Val	Val	Lys	Ser	Ile	Asn	Ile	Lys	Gly		
305					310					315				320			
Ser	Tyr	Val	Gly	Asn	Arg	Ala	Asp	Thr	Arg	Glu	Ala	Leu	Asp	Phe	Phe		
				325					330					335			
Ser	Arg	Gly	Leu	Ile	Lys	Ser	Pro	Ile	Lys	Ile	Val	Gly	Leu	Ser	Glu		
				340					345					350			
Leu	Pro	Lys	Val	Tyr	Asp	Leu	Met	Glu	Lys	Gly	Lys	Ile	Leu	Gly	Arg		
				355					360					365			
Tyr	Val	Val	Asp	Thr	Ser	Lys											
				370					375								
<210>	42																
<211>	1128																

<212> DNA

<213> 酿酒酵母

<400> 42

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gagaataagg ggaagctgca ttacaaagat atccctgtcc ccgagcctaa gccaaatgaa 180
attttaatat acgttaaata ttctgggtga tgtcacaccg atttacatgc ttggcacggc 240
gattggccat tacctgttaa actaccatta gtaggtggtc atgaaggtgc tgggtgtagtt 300
gtcaaactag gttccaatgt caagggctgg aaagtcgggtg atttagcagg tatcaaattg 360
ctgaacgggt cttgtatgac atgcgaattc tgtgaatcag gtcattgaatc aaattgtcca 420
gatgctgatt tatctgggta cactcatgat ggttctttcc aacaatttgc gaccgctgat 480
gctattcaag ccgccaaaat tcaacagggt accgacttgg ccgaagtagc cccaatatta 540
tgtgctgggt ttactgtata taaagcacta aaagaggcag acttgaaagc tggtgactgg 600
gttgccatct ctggtgctgc aggtggcttg ggttccttgg ccgttcaata tgcaactgcg 660
atgggttaca gagttctagg tattgatgca ggtgaggaaa aggaaaaact tttcaagaaa 720
ttgggggggt aagtattcat cgactttact aaaacaaaga atatggtttc tgacattcaa 780
gaagctacca aaggtggccc tcatggtgtc attaacgttt ccgtttctga agccgctatt 840
tctctatcta cggaatatgt tagaccatgt ggtaccgtcg ttttggttgg tttgccgct 900
aacgcctacg ttaaattcaga ggtattctct catgtggtga agtccatcaa tatcaagggt 960
tcttatgttg gtaacagagc tgatacgaga gaagccttag acttcttttag cagaggtttg 1020
atcaaatac caatcaaaat tgttggtgta tctgaattac caaaggttta tgacttgatg 1080
gaaaagggca agattttggg tagatacgtc gtcgatacta gtaaataa 1128

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<210> 43

<211> 382

<212> PRT

<213> 酿酒酵母

<400> 43

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Met Ser Ser Val Thr Gly Phe Tyr Ile Pro Pro Ile Ser Phe Phe Gly
1           5           10           15
Glu Gly Ala Leu Glu Glu Thr Ala Asp Tyr Ile Lys Asn Lys Asp Tyr
          20           25           30
Lys Lys Ala Leu Ile Val Thr Asp Pro Gly Ile Ala Ala Ile Gly Leu
          35           40           45
Ser Gly Arg Val Gln Lys Met Leu Glu Glu Arg Asp Leu Asn Val Ala
          50           55           60
Ile Tyr Asp Lys Thr Gln Pro Asn Pro Asn Ile Ala Asn Val Thr Ala
65           70           75           80
Gly Leu Lys Val Leu Lys Glu Gln Asn Ser Glu Ile Val Val Ser Ile
          85           90           95

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Gly Gly Gly Ser Ala His Asp Asn Ala Lys Ala Ile Ala Leu Leu Ala		
100	105	110
Thr Asn Gly Gly Glu Ile Gly Asp Tyr Glu Gly Val Asn Gln Ser Lys		
115	120	125
Lys Ala Ala Leu Pro Leu Phe Ala Ile Asn Thr Thr Ala Gly Thr Ala		
130	135	140
Ser Glu Met Thr Arg Phe Thr Ile Ile Ser Asn Glu Glu Lys Lys Ile		
145	150	155
Lys Met Ala Ile Ile Asp Asn Asn Val Thr Pro Ala Val Ala Val Asn		
165	170	175
Asp Pro Ser Thr Met Phe Gly Leu Pro Pro Ala Leu Thr Ala Ala Thr		
180	185	190
Gly Leu Asp Ala Leu Thr His Cys Ile Glu Ala Tyr Val Ser Thr Ala		
195	200	205
Ser Asn Pro Ile Thr Asp Ala Cys Ala Leu Lys Gly Ile Asp Leu Ile		
210	215	220
Asn Glu Ser Leu Val Ala Ala Tyr Lys Asp Gly Lys Asp Lys Lys Ala		
225	230	235
Arg Thr Asp Met Cys Tyr Ala Glu Tyr Leu Ala Gly Met Ala Phe Asn		
245	250	255
Asn Ala Ser Leu Gly Tyr Val His Ala Leu Ala His Gln Leu Gly Gly		
260	265	270
Phe Tyr His Leu Pro His Gly Val Cys Asn Ala Val Leu Leu Pro His		
275	280	285
Val Gln Glu Ala Asn Met Gln Cys Pro Lys Ala Lys Lys Arg Leu Gly		
290	295	300
Glu Ile Ala Leu His Phe Gly Ala Ser Gln Glu Asp Pro Glu Glu Thr		
305	310	315
Ile Lys Ala Leu His Val Leu Asn Arg Thr Met Asn Ile Pro Arg Asn		
325	330	335
Leu Lys Glu Leu Gly Val Lys Thr Glu Asp Phe Glu Ile Leu Ala Glu		
340	345	350
His Ala Met His Asp Ala Cys His Leu Thr Asn Pro Val Gln Phe Thr		
355	360	365
Lys Glu Gln Val Val Ala Ile Ile Lys Lys Ala Tyr Glu Tyr		
370	375	380

<210> 44

<211> 1149

<212> DNA

<213> 酿酒酵母

<400> 44

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cctgggtattg cagctattgg tctctccggt agagtccaaa agatgttga agaacgtgac 180
ttaaacgttg ctatctatga caaaactcaa ccaaaccxaa atattgcaa tgtcacagct 240
ggtttgaagg ttttgaagga aaaaaactct gaaattgttg tttccattgg tgggtggttct 300
gctcacgaca atgctaaggc cattgcttta ttggctacta acggtgggga aatcgagac 360
tatgaaggtg tcaatcaatc taagaaggct gctttaccac tatttgccat caacactact 420
gctggtagtg cttccgaaat gaccagattc actattatct ctaatgaaga aaagaaaatc 480
aagatggcta tcattgacaa caacgtcact ccagctgttg ctgtcaacga tccatctacc 540
atgtttggtt tgccacctgc tttgactgct gctactggtc tagatgcttt gactcactgt 600
atcgaagctt atgtttccac cgctctaac ccaatcaccg atgcctgtgc tttgaagggt 660
attgatttga tcaatgaaag cttagtcgct gcatacaaag acggtaaaga caagaaggcc 720
agaactgaca tgtgttacgc tgaatacttg gcaggtatgg ctttcaacaa tgcttctcta 780
ggttatgttc atgcccttgc tcatcaactt ggtggtttct accacttgcc tcatggtgtt 840
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aagagattag gtgaaattgc tttgcatttc ggtgcttctc aagaagatcc agaagaaacc 960
atcaaggctt tgcacgtttt aaacagaacc atgaacattc caagaaactt gaaagaatta 1020
ggtgttaaaa ccgaagattt tgaaattttg gctgaacacg ccatgcatga tgcttgccat 1080
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<210> 45

<211> 351

<212> PRT

<213> 酿酒酵母

<400> 45

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Met Pro Ser Gln Val Ile Pro Glu Lys Gln Lys Ala Ile Val Phe Tyr
1           5           10           15
Glu Thr Asp Gly Lys Leu Glu Tyr Lys Asp Val Thr Val Pro Glu Pro
          20           25           30
Lys Pro Asn Glu Ile Leu Val His Val Lys Tyr Ser Gly Val Cys His
          35           40           45
Ser Asp Leu His Ala Trp His Gly Asp Trp Pro Phe Gln Leu Lys Phe
          50           55           60
Pro Leu Ile Gly Gly His Glu Gly Ala Gly Val Val Val Lys Leu Gly
65           70           75           80
Ser Asn Val Lys Gly Trp Lys Val Gly Asp Phe Ala Gly Ile Lys Trp
          85           90           95

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Leu Asn Gly Thr Cys Met Ser Cys Glu Tyr Cys Glu Val Gly Asn Glu		
100	105	110
Ser Gln Cys Pro Tyr Leu Asp Gly Thr Gly Phe Thr His Asp Gly Thr		
115	120	125
Phe Gln Glu Tyr Ala Thr Ala Asp Ala Val Gln Ala Ala His Ile Pro		
130	135	140
Pro Asn Val Asn Leu Ala Glu Val Ala Pro Ile Leu Cys Ala Gly Ile		
145	150	155
Thr Val Tyr Lys Ala Leu Lys Arg Ala Asn Val Ile Pro Gly Gln Trp		
165	170	175
Val Thr Ile Ser Gly Ala Cys Gly Gly Leu Gly Ser Leu Ala Ile Gln		
180	185	190
Tyr Ala Leu Ala Met Gly Tyr Arg Val Ile Gly Ile Asp Gly Gly Asn		
195	200	205
Ala Lys Arg Lys Leu Phe Glu Gln Leu Gly Gly Glu Ile Phe Ile Asp		
210	215	220
Phe Thr Glu Glu Lys Asp Ile Val Gly Ala Ile Ile Lys Ala Thr Asn		
225	230	235
Gly Gly Ser His Gly Val Ile Asn Val Ser Val Ser Glu Ala Ala Ile		
245	250	255
Glu Ala Ser Thr Arg Tyr Cys Arg Pro Asn Gly Thr Val Val Leu Val		
260	265	270
Gly Met Pro Ala His Ala Tyr Cys Asn Ser Asp Val Phe Asn Gln Val		
275	280	285
Val Lys Ser Ile Ser Ile Val Gly Ser Cys Val Gly Asn Arg Ala Asp		
290	295	300
Thr Arg Glu Ala Leu Asp Phe Phe Ala Arg Gly Leu Ile Lys Ser Pro		
305	310	315
Ile His Leu Ala Gly Leu Ser Asp Val Pro Glu Ile Phe Ala Lys Met		
325	330	335
Glu Lys Gly Glu Ile Val Gly Arg Tyr Val Val Glu Thr Ser Lys		
340	345	350

<210> 46

<211> 1056

<212> DNA

<213> 酿酒酵母

<400> 46

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gttaaataatt ctgggtgtttg tcatagtgac ttgcacgcgt ggcacgggtga ttggccattt 180
 caattgaaat ttccattaat cggtgggtcac gaaggtgctg gtgttggtgt taagttggga 240
 tctaacgtta agggctggaa agtcggtgat tttgcaggta taaaatggtt gaatgggact 300
 tgcattgtcct gtgaatattg tgaagtaggt aatgaatctc aatgtcctta tttggatggt 360
 actggcttca cacatgatgg tacttttcaa gaatacgcaa ctgccgatgc cgttcaagct 420
 gcccatattc caccaaactg caatcttgct gaagttgccc caatcttggtg tgcaggtatc 480
 actgtttata aggcgttgaa aagagccaat gtgataccag gccaatgggt cactatatcc 540
 ggtgcatgctg gtggcttggg ttctctggca atccaatacg cccttgctat gggttacagg 600
 gtcattggta tcatggtggt taatgccaag cgaaagtatt ttgaacaatt aggcggagaa 660
 atattcatcg atttcacgga agaaaaagac attgtttggtg ctataataaa ggccactaat 720
 ggcggttctc atggagtatt taatgtgtct gtttctgaag cagctatcga ggcttctacg 780
 aggtattgta ggccaatgg tactgtcgtc ctggttggtg tgccagctca tgcttactgc 840
 aattccgatg ttttcaatca agttgtaaaa tcaatctcca tcgttggtatc ttgtgttgga 900
 aatagagctg atacaaggga ggcttttagat ttcttcgcca gaggtttgat caaatctccg 960
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<210> 47

<211> 360

<212> PRT

<213> 酿酒酵母

<400> 47

Met	Ser	Tyr	Pro	Glu	Lys	Phe	Glu	Gly	Ile	Ala	Ile	Gln	Ser	His	Glu
1				5					10					15	
Asp	Trp	Lys	Asn	Pro	Lys	Lys	Thr	Lys	Tyr	Asp	Pro	Lys	Pro	Phe	Tyr
			20					25					30		
Asp	His	Asp	Ile	Asp	Ile	Lys	Ile	Glu	Ala	Cys	Gly	Val	Cys	Gly	Ser
			35				40						45		
Asp	Ile	His	Cys	Ala	Ala	Gly	His	Trp	Gly	Asn	Met	Lys	Met	Pro	Leu
			50				55				60				
Val	Val	Gly	His	Glu	Ile	Val	Gly	Lys	Val	Val	Lys	Leu	Gly	Pro	Lys
65					70					75					80
Ser	Asn	Ser	Gly	Leu	Lys	Val	Gly	Gln	Arg	Val	Gly	Val	Gly	Ala	Gln
				85					90						95
Val	Phe	Ser	Cys	Leu	Glu	Cys	Asp	Arg	Cys	Lys	Asn	Asp	Asn	Glu	Pro
				100					105					110	
Tyr	Cys	Thr	Lys	Phe	Val	Thr	Thr	Tyr	Ser	Gln	Pro	Tyr	Glu	Asp	Gly
				115					120					125	
Tyr	Val	Ser	Gln	Gly	Gly	Tyr	Ala	Asn	Tyr	Val	Arg	Val	His	Glu	His
				130				135						140	

Phe Val Val Pro Ile Pro Glu Asn Ile Pro Ser His Leu Ala Ala Pro			
145	150	155	160
Leu Leu Cys Gly Gly Leu Thr Val Tyr Ser Pro Leu Val Arg Asn Gly			
	165	170	175
Cys Gly Pro Gly Lys Lys Val Gly Ile Val Gly Leu Gly Gly Ile Gly			
	180	185	190
Ser Met Gly Thr Leu Ile Ser Lys Ala Met Gly Ala Glu Thr Tyr Val			
	195	200	205
Ile Ser Arg Ser Ser Arg Lys Arg Glu Asp Ala Met Lys Met Gly Ala			
	210	215	220
Asp His Tyr Ile Ala Thr Leu Glu Glu Gly Asp Trp Gly Glu Lys Tyr			
225	230	235	240
Phe Asp Thr Phe Asp Leu Ile Val Val Cys Ala Ser Ser Leu Thr Asp			
	245	250	255
Ile Asp Phe Asn Ile Met Pro Lys Ala Met Lys Val Gly Gly Arg Ile			
	260	265	270
Val Ser Ile Ser Ile Pro Glu Gln His Glu Met Leu Ser Leu Lys Pro			
	275	280	285
Tyr Gly Leu Lys Ala Val Ser Ile Ser Tyr Ser Ala Leu Gly Ser Ile			
	290	295	300
Lys Glu Leu Asn Gln Leu Leu Lys Leu Val Ser Glu Lys Asp Ile Lys			
305	310	315	320
Ile Trp Val Glu Thr Leu Pro Val Gly Glu Ala Gly Val His Glu Ala			
	325	330	335
Phe Glu Arg Met Glu Lys Gly Asp Val Arg Tyr Arg Phe Thr Leu Val			
	340	345	350
Gly Tyr Asp Lys Glu Phe Ser Asp			
	355	360	

<210> 48

<211> 1083

<212> DNA

<213> 酿酒酵母

<400> 48

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gaagcatgtg gtgtctgcgg tagtgatatt cattgtgcag ctggtcattg gggcaatatg 180
aagatgccgc tagtcgttgg tcatgaaatc gttggtaaag ttgtcaagct agggcccaag 240
tcaaacagtg gggtgaaagt cgggtcaacgt gttggtgtag gtgctcaagt cttttcatgc 300
ttggaatgtg accgttgtaa gaatgataat gaaccatact gcaccaagtt tgttaccaca 360

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tacagtcagc cttatgaaga cggctatgtg tcgcagggtg gctatgcaaa ctacgtcaga 420
 gttcatgaac attttgttgt gcctatccca gagaatattc catcacattt ggctgctcca 480
 ctattatgtg gtggtttgac tgtgtactct ccattggttc gtaacggttg cggtcaggt 540
 aaaaaagttg gtatagttgg tcttggtggg atcggcagta tgggtacatt gatttcctaaa 600
 gccatggggg cagagacgta tggtatttct cgttcttcga gaaaaagaga agatgcaatg 660
 aagatgggcg ccgataccta cattgctaca ttagaagaag gtgattgggg tgaaaagtac 720
 tttgacacct tcgacctgat ttagtctgt gtttctctcc ttaccgacat tgacttcaac 780
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 cagaaatgt tatcgctaaa gccatatggc ttaaaggctg tctccatttc ttacagtgt 900
 ttaggttcca tcaaagaatt gaaccaactc ttgaaattag tctctgaaaa agatatcaaa 960
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 tag 1083

<210> 49

<211> 361

<212> PRT

<213> 酿酒酵母

<400> 49

Met	Leu	Tyr	Pro	Glu	Lys	Phe	Gln	Gly	Ile	Gly	Ile	Ser	Asn	Ala	Lys
1				5				10						15	
Asp	Trp	Lys	His	Pro	Lys	Leu	Val	Ser	Phe	Asp	Pro	Lys	Pro	Phe	Gly
				20				25						30	
Asp	His	Asp	Val	Asp	Val	Glu	Ile	Glu	Ala	Cys	Gly	Ile	Cys	Gly	Ser
				35				40						45	
Asp	Phe	His	Ile	Ala	Val	Gly	Asn	Trp	Gly	Pro	Val	Pro	Glu	Asn	Gln
				50				55						60	
Ile	Leu	Gly	His	Glu	Ile	Ile	Gly	Arg	Val	Val	Lys	Val	Gly	Ser	Lys
65					70				75						80
Cys	His	Thr	Gly	Val	Lys	Ile	Gly	Asp	Arg	Val	Gly	Val	Gly	Ala	Gln
				85					90						95
Ala	Leu	Ala	Cys	Phe	Glu	Cys	Glu	Arg	Cys	Lys	Ser	Asp	Asn	Glu	Gln
				100					105					110	
Tyr	Cys	Thr	Asn	Asp	His	Val	Leu	Thr	Met	Trp	Thr	Pro	Tyr	Lys	Asp
				115					120					125	
Gly	Tyr	Ile	Ser	Gln	Gly	Gly	Phe	Ala	Ser	His	Val	Arg	Leu	His	Glu
				130					135					140	
His	Phe	Ala	Ile	Gln	Ile	Pro	Glu	Asn	Ile	Pro	Ser	Pro	Leu	Ala	Ala
145					150					155					160
Pro	Leu	Leu	Cys	Gly	Gly	Ile	Thr	Val	Phe	Ser	Pro	Leu	Leu	Arg	Asn

	165		170		175
Gly Cys Gly Pro Gly Lys Arg Val Gly Ile Val Gly Ile Gly Gly Ile					
	180		185		190
Gly His Met Gly Ile Leu Leu Ala Lys Ala Met Gly Ala Glu Val Tyr					
	195		200		205
Ala Phe Ser Arg Gly His Ser Lys Arg Glu Asp Ser Met Lys Leu Gly					
	210		215		220
Ala Asp His Tyr Ile Ala Met Leu Glu Asp Lys Gly Trp Thr Glu Gln					
225		230		235	240
Tyr Ser Asn Ala Leu Asp Leu Leu Val Val Cys Ser Ser Ser Leu Ser					
	245		250		255
Lys Val Asn Phe Asp Ser Ile Val Lys Ile Met Lys Ile Gly Gly Ser					
	260		265		270
Ile Val Ser Ile Ala Ala Pro Glu Val Asn Glu Lys Leu Val Leu Lys					
	275		280		285
Pro Leu Gly Leu Met Gly Val Ser Ile Ser Ser Ser Ala Ile Gly Ser					
	290		295		300
Arg Lys Glu Ile Glu Gln Leu Leu Lys Leu Val Ser Glu Lys Asn Val					
305		310		315	320
Lys Ile Trp Val Glu Lys Leu Pro Ile Ser Glu Glu Gly Val Ser His					
	325		330		335
Ala Phe Thr Arg Met Glu Ser Gly Asp Val Lys Tyr Arg Phe Thr Leu					
	340		345		350
Val Asp Tyr Asp Lys Lys Phe His Lys					
	355		360		

<210> 50

<211> 1086

<212> DNA

<213> 酿酒酵母

<400> 50

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gaagcctgtg gtatctgcgg atctgatttt catatagccg ttggtaattg ggggtccagtc 180
ccagaaaatc aaatccttgg acatgaaata attggccgcg tggatgaagg tggatccaag 240
tgccacactg gggtaaaaaat cggtgaccgt gttggtgttg gtgccaagc cttggcgtgt 300
tttgagtgtg aacgttgcaa aagtgacaac gagcaatact gtaccaatga ccacgttttg 360
actatgtgga ctccttaciaa ggacggctac atttcacaag gaggctttgc ctcccacgtg 420
aggcttcatg aacactttgc tattcaaata ccagaaaata ttccaagtcc gctagccgct 480
ccattattgt gtggtggtat tacagttttc tctccactac taagaaatgg ctgtggtcca 540

ggtaagaggg taggtattgt tggcatcggg ggtattgggc atatggggat tctgttggct 600
 aaagctatgg gagccgaggt ttatgcgttt tcgcgaggcc actccaagcg ggaggattct 660
 atgaaactcg gtgctgatca ctatattgct atgttggagg ataaaggctg gacagaacaa 720
 tactctaacg ctttggacct tcttgtcggt tgctcatcat ctttgtcgaa agttaatttt 780
 gacagtatcg ttaagattat gaagattgga ggctccatcg tttcaattgc tgctcctgaa 840
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 gctatcggat ctaggaagga aatcgaacaa ctattgaaat tagtttccga aaagaatgtc 960
 aaaatatggg tggaaaaaact tccgatcagc gaagaaggcg tcagccatgc ctttacaagg 1020
 atggaaaagcg gagacgtcaa atacagattt actttggtcg attatgataa gaaattccat 1080
 aaatag 1086

<210> 51

<211> 386

<212> PRT

<213> 酿酒酵母

<400> 51

Met	Ser	Ala	Ala	Thr	Val	Gly	Lys	Pro	Ile	Lys	Cys	Ile	Ala	Ala	Val
1				5				10				15			
Ala	Tyr	Asp	Ala	Lys	Lys	Pro	Leu	Ser	Val	Glu	Glu	Ile	Thr	Val	Asp
			20					25				30			
Ala	Pro	Lys	Ala	His	Glu	Val	Arg	Ile	Lys	Ile	Glu	Tyr	Thr	Ala	Val
			35					40				45			
Cys	His	Thr	Asp	Ala	Tyr	Thr	Leu	Ser	Gly	Ser	Asp	Pro	Glu	Gly	Leu
			50				55				60				
Phe	Pro	Cys	Val	Leu	Gly	His	Glu	Gly	Ala	Gly	Ile	Val	Glu	Ser	Val
65				70				75				80			
Gly	Asp	Asp	Val	Ile	Thr	Val	Lys	Pro	Gly	Asp	His	Val	Ile	Ala	Leu
			85					90				95			
Tyr	Thr	Ala	Glu	Cys	Gly	Lys	Cys	Lys	Phe	Cys	Thr	Ser	Gly	Lys	Thr
			100					105				110			
Asn	Leu	Cys	Gly	Ala	Val	Arg	Ala	Thr	Gln	Gly	Lys	Gly	Val	Met	Pro
			115				120				125				
Asp	Gly	Thr	Thr	Arg	Phe	His	Asn	Ala	Lys	Gly	Glu	Asp	Ile	Tyr	His
			130				135				140				
Phe	Met	Gly	Cys	Ser	Thr	Phe	Ser	Glu	Tyr	Thr	Val	Val	Ala	Asp	Val
145				150				155				160			
Ser	Val	Val	Ala	Ile	Asp	Pro	Lys	Ala	Pro	Leu	Asp	Ala	Ala	Cys	Leu
			165					170				175			
Leu	Gly	Cys	Gly	Val	Thr	Thr	Gly	Phe	Gly	Ala	Ala	Leu	Lys	Thr	Ala
			180					185				190			

Asn Val Gln Lys Gly Asp Thr Val Ala Val Phe Gly Cys Gly Thr Val		
195	200	205
Gly Leu Ser Val Ile Gln Gly Ala Lys Leu Arg Gly Ala Ser Lys Ile		
210	215	220
Ile Ala Ile Asp Ile Asn Asn Lys Lys Lys Gln Tyr Cys Ser Gln Phe		
225	230	235
Gly Ala Thr Asp Phe Val Asn Pro Lys Glu Asp Leu Ala Lys Asp Gln		
	245	250
Thr Ile Val Glu Lys Leu Ile Glu Met Thr Asp Gly Gly Leu Asp Phe		
	260	265
Thr Phe Asp Cys Thr Gly Asn Thr Lys Ile Met Arg Asp Ala Leu Glu		
	275	280
Ala Cys His Lys Gly Trp Gly Gln Ser Ile Ile Ile Gly Val Ala Ala		
	290	295
Ala Gly Glu Glu Ile Ser Thr Arg Pro Phe Gln Leu Val Thr Gly Arg		
305	310	315
Val Trp Lys Gly Ser Ala Phe Gly Gly Ile Lys Gly Arg Ser Glu Met		
	325	330
Gly Gly Leu Ile Lys Asp Tyr Gln Lys Gly Ala Leu Lys Val Glu Glu		
	340	345
Phe Ile Thr His Arg Arg Pro Phe Lys Glu Ile Asn Gln Ala Phe Glu		
	355	360
Asp Leu His Asn Gly Asp Cys Leu Arg Thr Val Leu Lys Ser Asp Glu		
	370	375
Ile Lys		
385		

<210> 52

<211> 1161

<212> DNA

<213> 酿酒酵母

<400> 52

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atcaaaaattg aatatactgc tgtatgccac actgatgcgt acactttatc aggctctgat 180
ccagaaggac ttttcccttg cgttctgggc cacgaaggag ccggtatcgt agaatctgta 240
ggcgatgatg tcataacagt taagcctggt gatcatgtta ttgctttgta cactgctgag 300
tgtggcaaat gtaagttctg tacttccggt aaaaccaact tatgtggtgc tgtagagct 360
actcaaggga aaggtgtaat gcctgatggg accacaagat ttcataatgc gaaaggtgaa 420
gatataacc atttcatggg ttgctctact ttttccgaat atactgtggt ggcagatgtc 480

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 gcagtatttg gctgcgggac ttaggactc tccgttatcc aaggtgcaaa gttaaggggc 660
 gcttccaaga tcattgccat tgacattaac aataagaaaa aacaatattg ttctcaattt 720
 ggtgccacgg attttgttaa tccaaggaa gatttggcca aagatcaaac tatcgttgaa 780
 aagttaattg aaatgactga tgggggtctg gattttactt ttgactgtac tggtaatacc 840
 aaaattatga gagatgcttt ggaagcctgt cataaagggt ggggtcaatc tattatcatt 900
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 gtgtggaaaag gctctgcttt tgggtggcatc aaaggtagat ctgaaatggg cggtttaatt 1020
 aaagactatc aaaaagggtgc cttaaaagtc gaagaattta tcactcacag gagaccattc 1080
 aaagaaatca atcaagcctt tgaagatttg cataacggtg attgcttaag aaccgtcttg 1140
 aagtctgatg aaataaaaata g 1161

<210> 53

<211> 363

<212> PRT

<213> 酿酒酵母

<400> 53

Met	Ile	Gly	Ser	Ala	Ser	Asp	Ser	Ser	Ser	Lys	Leu	Gly	Arg	Leu	Arg
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Phe	Leu	Ser	Glu	Thr	Ala	Ala	Ile	Lys	Val	Ser	Pro	Leu	Ile	Leu	Gly
				20				25						30	
Glu	Val	Ser	Tyr	Asp	Gly	Ala	Arg	Ser	Asp	Phe	Leu	Lys	Ser	Met	Asn
				35				40						45	
Lys	Asn	Arg	Ala	Phe	Glu	Leu	Leu	Asp	Thr	Phe	Tyr	Glu	Ala	Gly	Gly
				50				55						60	
Asn	Phe	Ile	Asp	Ala	Ala	Asn	Asn	Cys	Gln	Asn	Glu	Gln	Ser	Glu	Glu
65				70				75						80	
Trp	Ile	Gly	Glu	Trp	Ile	Gln	Ser	Arg	Arg	Leu	Arg	Asp	Gln	Ile	Val
				85				90						95	
Ile	Ala	Thr	Lys	Phe	Ile	Lys	Ser	Asp	Lys	Lys	Tyr	Lys	Ala	Gly	Glu
				100				105						110	
Ser	Asn	Thr	Ala	Asn	Tyr	Cys	Gly	Asn	His	Lys	Arg	Ser	Leu	His	Val
				115				120						125	
Ser	Val	Arg	Asp	Ser	Leu	Arg	Lys	Leu	Gln	Thr	Asp	Trp	Ile	Asp	Ile
				130				135						140	
Leu	Tyr	Val	His	Trp	Trp	Asp	Tyr	Met	Ser	Ser	Ile	Glu	Glu	Phe	Met
145				150				155						160	
Asp	Ser	Leu	His	Ile	Leu	Val	Gln	Gln	Gly	Lys	Val	Leu	Tyr	Leu	Gly
				165				170						175	

Val Ser Asp Thr Pro Ala Trp Val Val Ser Ala Ala Asn Tyr Tyr Ala		
180	185	190
Thr Ser Tyr Gly Lys Thr Pro Phe Ser Ile Tyr Gln Gly Lys Trp Asn		
195	200	205
Val Leu Asn Arg Asp Phe Glu Arg Asp Ile Ile Pro Met Ala Arg His		
210	215	220
Phe Gly Met Ala Leu Ala Pro Trp Asp Val Met Gly Gly Gly Arg Phe		
225	230	235
Gln Ser Lys Lys Ala Met Glu Glu Arg Arg Lys Asn Gly Glu Gly Ile		
245	250	255
Arg Ser Phe Val Gly Ala Ser Glu Gln Thr Asp Ala Glu Ile Lys Ile		
260	265	270
Ser Glu Ala Leu Ala Lys Ile Ala Glu Glu His Gly Thr Glu Ser Val		
275	280	285
Thr Ala Ile Ala Ile Ala Tyr Val Arg Ser Lys Ala Lys Asn Phe Phe		
290	295	300
Pro Ser Val Glu Gly Gly Lys Ile Glu Asp Leu Lys Glu Asn Ile Lys		
305	310	315
Ala Leu Ser Ile Asp Leu Thr Pro Asp Asn Ile Lys Tyr Leu Glu Ser		
325	330	335
Ile Val Pro Phe Asp Ile Gly Phe Pro Asn Asn Phe Ile Val Leu Asn		
340	345	350
Ser Leu Thr Gln Lys Tyr Gly Thr Asn Asn Val		
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<210> 54

<211> 1092

<212> DNA

<213> 酿酒酵母

<400> 54

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tcggattttc tcaaataaat gaacaagaat cgagcttttg aattgcttga tactttttac 180
gaggcaggtg gaaatttcat tgatgccgca aacaactgcc aaaacgagca atcagaagaa 240
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tggattgata tactttacgt tcaactgttg gattatatga gttcaatcga agaatttatg 480
gatagtttgc atattctggt ccagcagggc aaggtcctct atttggtgt atctgataca 540
cctgcttggg ttgtttctgc ggcaaaactac tacgctacat cttatggtaa aactcccttt 600

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 cagagtaaaa aagcaatgga ggaacggagg aagaatggag agggtattcg ttctttcgtt 780
 ggcgcctccg aacaaacaga tgcagaaatc aagattagtg aagcattggc caagattgct 840
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 aaaaattttt ttccgtcggg tgaaggagga aaaattgagg atctcaaaga gaacattaag 960
 gctctcagta tcgatctaac gccagacaat ataaaatact tagaaagtat agttcctttt 1020
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<210> 55

<211> 329

<212> PRT

<213> 酿酒酵母

<400> 55

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			20					25						30	
Glu	Glu	Ser	Glu	Ile	Trp	Ile	Gly	Glu	Trp	Met	Lys	Ser	Arg	Lys	Leu
			35					40						45	
Arg	Asp	Gln	Ile	Val	Ile	Ala	Thr	Lys	Phe	Thr	Gly	Asp	Tyr	Lys	Lys
			50					55						60	
Tyr	Glu	Val	Gly	Gly	Gly	Lys	Ser	Ala	Asn	Tyr	Cys	Gly	Asn	His	Lys
65						70					75				80
His	Ser	Leu	His	Val	Ser	Val	Arg	Asp	Ser	Leu	Arg	Lys	Leu	Gln	Thr
						85					90				95
Asp	Trp	Ile	Asp	Ile	Leu	Tyr	Val	His	Trp	Trp	Asp	Tyr	Met	Ser	Ser
						100					105				110
Ile	Glu	Glu	Val	Met	Asp	Ser	Leu	His	Ile	Leu	Val	Gln	Gln	Gly	Lys
						115								125	
Val	Leu	Tyr	Leu	Gly	Val	Ser	Asp	Thr	Pro	Ala	Trp	Val	Val	Ser	Ala
						130					135				140
Ala	Asn	Tyr	Tyr	Ala	Thr	Ser	His	Gly	Lys	Thr	Pro	Phe	Ser	Ile	Tyr
145							150					155			160
Gln	Gly	Lys	Trp	Asn	Val	Leu	Asn	Arg	Asp	Phe	Glu	Arg	Asp	Ile	Ile
						165								175	
Pro	Met	Ala	Arg	His	Phe	Gly	Met	Ala	Leu	Ala	Pro	Trp	Asp	Val	Met
						180								190	
Gly	Gly	Gly	Arg	Phe	Gln	Ser	Lys	Lys	Ala	Met	Glu	Glu	Arg	Lys	Lys

195	200	205
Asn Gly Glu Gly Leu Arg Thr Val Ser Gly Thr Ser Lys Gln Thr Asp		
210	215	220
Lys Glu Val Lys Ile Ser Glu Ala Leu Ala Lys Val Ala Glu Glu His		
225	230	235
Gly Thr Glu Ser Val Thr Ala Ile Ala Ile Ala Tyr Val Arg Ser Lys		
245	250	255
Ala Lys Asn Val Phe Pro Leu Val Gly Gly Arg Lys Ile Glu His Leu		
260	265	270
Lys Gln Asn Ile Glu Ala Leu Ser Ile Lys Leu Thr Pro Glu Gln Ile		
275	280	285
Glu Tyr Leu Glu Ser Ile Ile Pro Phe Asp Val Gly Phe Pro Thr Asn		
290	295	300
Phe Ile Gly Asp Asp Pro Ala Val Thr Lys Lys Ala Ser Leu Leu Thr		
305	310	315
Ala Met Ser Ala Gln Ile Ser Phe Asp		
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<210> 56

<211> 990

<212> DNA

<213> 酿酒酵母

<400> 56

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gaatggatga aatcaagaaa gttgcgtgac caaattgtaa ttgccaccaa gtttaccgga 180
gattataaga agtatgaagt aggtggcggg aaaagtgcc actattgttg taatcacaag 240
catagtttac atgtgagtgt gagggattct ctccgcaaat tgcaaactga ttggattgat 300
atacttttacg ttcactgggtg ggattatatg agttcaatcg aagaagttat ggatagtttg 360
catattttag ttcagcaggg caaagtcctc tatttgggtg tgtctgatac acctgcttgg 420
gttgtttctg cggcaaaacta ctacgccaca tctcatggga aaactccttt tagtatctat 480
caaggtaaat ggaatgtgtt gaacagggac tttgagcgcg atatcattcc aatggccaga 540
cattttggtg tggctctagc cccatgggat gttatgggag gtggaagatt tcagagtaaa 600
aaagcaatgg aggaacggaa gaagaatgga gagggctctg gtactgtttc ggggtacttct 660
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ggcactgagt ctgttactgc tattgctatt gcctatgttc gctctaaggc gaaaaatgtt 780
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atcaaactga caccagaaca gatagaatac ttagaaagta ttattccttt tgatgttggt 900
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<210> 57

<211> 288

<212> PRT

<213> 酿酒酵母

<400> 57

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Thr Thr Asp Tyr Lys Gly Tyr Asp Val Gly Lys Gly Lys Ser Ala Asn
          20           25           30
Phe Cys Gly Asn His Lys Arg Ser Leu His Val Ser Val Arg Asp Ser
          35           40           45
Leu Arg Lys Leu Gln Thr Asp Trp Ile Asp Ile Leu Tyr Val His Trp
          50           55           60
Trp Asp Tyr Met Ser Ser Ile Glu Glu Val Met Asp Ser Leu His Ile
65           70           75           80
Leu Val Gln Gln Gly Lys Val Leu Tyr Leu Gly Val Ser Asp Thr Pro
          85           90           95
Ala Trp Val Val Ser Ala Ala Asn Tyr Tyr Ala Thr Ser His Gly Lys
          100          105          110
Thr Pro Phe Ser Ile Tyr Gln Gly Lys Trp Asn Val Leu Asn Arg Asp
          115          120          125
Phe Glu Arg Asp Ile Ile Pro Met Ala Arg His Phe Gly Met Ala Leu
          130          135          140
Ala Pro Trp Asp Val Met Gly Gly Gly Arg Phe Gln Ser Lys Lys Ala
          145          150          155          160
Val Glu Glu Arg Lys Lys Lys Gly Glu Gly Leu Arg Thr Phe Phe Gly
          165          170          175
Thr Ser Glu Gln Thr Asp Met Glu Val Lys Ile Ser Glu Ala Leu Leu
          180          185          190
Lys Val Ala Glu Glu His Gly Thr Glu Ser Val Thr Ala Ile Ala Ile
          195          200          205
Ala Tyr Val Arg Ser Lys Ala Lys His Val Phe Pro Leu Val Gly Gly
          210          215          220
Arg Lys Ile Glu His Leu Lys Gln Asn Ile Glu Ala Leu Ser Ile Lys
          225          230          235          240
Leu Thr Pro Glu Gln Ile Lys Tyr Leu Glu Ser Ile Val Pro Phe Asp
          245          250          255
Val Gly Phe Pro Thr Asn Phe Ile Gly Asp Asp Pro Ala Val Thr Lys
          260          265          270

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Lys Pro Ser Phe Leu Thr Glu Met Ser Ala Lys Ile Ser Phe Glu Asp
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<210> 58

<211> 867

<212> DNA

<213> 酿酒酵母

<400> 58

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 ttgcatgtaa gtgtgagaga ttcccttcgt aagttgcaaa ctgattggat tgatattctt 180
 tacgttcact ggtgggatta tatgagctcc attgaggaag ttatggatag tttgcacatt 240
 cttgtgcagc agggcaaaagt actctatcta ggtgtgtctg atactcctgc ctgggttggt 300
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<210> 59

<211> 376

<212> PRT

<213> 酿酒酵母

<400> 59

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 20 25 30
 Ile Leu Gly Gly Ala Ser Ile Gly Asp Ala Trp Ser Gly Phe Met Gly
 35 40 45
 Ser Met Asn Lys Glu Gln Ala Phe Glu Leu Leu Asp Ala Phe Tyr Glu
 50 55 60
 Ala Gly Gly Asn Cys Ile Asp Thr Ala Asn Ser Tyr Gln Asn Glu Glu
 65 70 75 80
 Ser Glu Ile Trp Ile Gly Glu Trp Met Ala Ser Arg Lys Leu Arg Asp
 85 90 95

Gln Ile Val Ile Ala Thr Lys Phe Thr Gly Asp Tyr Lys Lys Tyr Glu		
100	105	110
Val Gly Gly Gly Lys Ser Ala Asn Tyr Cys Gly Asn His Lys Arg Ser		
115	120	125
Leu His Val Ser Val Arg Asp Ser Leu Arg Lys Leu Gln Thr Asp Trp		
130	135	140
Ile Asp Ile Leu Tyr Ile His Trp Trp Asp Tyr Met Ser Ser Ile Glu		
145	150	155
Glu Val Met Asp Ser Leu His Ile Leu Val Gln Gln Gly Lys Val Leu		
165	170	175
Tyr Leu Gly Val Ser Asp Thr Pro Ala Trp Val Val Ser Ala Ala Asn		
180	185	190
Tyr Tyr Ala Thr Ser His Gly Lys Thr Pro Phe Ser Val Tyr Gln Gly		
195	200	205
Lys Trp Asn Val Leu Asn Arg Asp Phe Glu Arg Asp Ile Ile Pro Met		
210	215	220
Ala Arg His Phe Gly Met Ala Leu Ala Pro Trp Asp Val Met Gly Gly		
225	230	235
Gly Arg Phe Gln Ser Lys Lys Ala Met Glu Glu Arg Lys Lys Asn Gly		
245	250	255
Glu Gly Leu Arg Thr Phe Val Gly Gly Pro Glu Gln Thr Glu Leu Glu		
260	265	270
Val Lys Ile Ser Glu Ala Leu Thr Lys Ile Ala Glu Glu His Gly Thr		
275	280	285
Glu Ser Val Thr Ala Ile Ala Ile Ala Tyr Val Arg Ser Lys Ala Lys		
290	295	300
Asn Val Phe Pro Leu Ile Gly Gly Arg Lys Ile Glu His Leu Lys Gln		
305	310	315
Asn Ile Glu Ala Leu Ser Ile Lys Leu Thr Pro Glu Gln Ile Glu Tyr		
325	330	335
Leu Glu Ser Ile Val Pro Phe Asp Val Gly Phe Pro Lys Ser Leu Ile		
340	345	350
Gly Asp Asp Pro Ala Val Thr Lys Lys Leu Ser Pro Leu Thr Ser Met		
355	360	365
Ser Ala Arg Ile Ala Phe Asp Asn		
370	375	
<210> 60		
<211> 1131		
<212> DNA		

<213> 酿酒酵母

<400> 60

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 gccaccaagt ttaccggaga ttataagaag tatgaagtag gtggtggtaa aagtgccaac 360
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 caaactgatt ggattgatat actttacatt cactgggtggg attatatgag ttcaatcgaa 480
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 aacattgagg ctttgagtat taaattaaca ccggaacaaa tagaatacct ggaaagtatt 1020
 gttccttttg atgttggtt tcccaaaagt ttaataggag atgaccagc ggtaaccaag 1080
 aagctttcac ccctcacatc gatgtctgcc aggatagctt ttgacaatta g 1131

<210> 61

<211> 143

<212> PRT

<213> 酿酒酵母

<400> 61

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 20 25 30
 Gly Glu Cys Ile Arg Ser Phe Val Gly Ala Ser Glu Gln Thr Asp Ala
 35 40 45
 Glu Ile Lys Ile Ser Glu Ala Leu Ala Lys Val Ala Glu Glu His Gly
 50 55 60
 Thr Glu Ser Val Thr Ala Ile Ala Ile Ala Tyr Val Arg Ser Lys Ala
 65 70 75 80
 Lys Asn Val Phe Pro Ser Val Glu Gly Gly Lys Ile Glu Asp Leu Lys
 85 90 95
 Glu Asn Ile Lys Ala Leu Ser Ile Asp Leu Thr Pro Asp Asn Ile Lys

100	105	110
Tyr Leu Glu Asn Val Val Pro Phe Asp Ile Gly Phe Pro Asn Thr Phe		
115	120	125
Ile Val Leu Asn Ser Leu Thr Gln Lys Tyr Gly Thr Asn Asn Val		
130	135	140
<210> 62		
<211> 432		
<212> DNA		
<213> 酿酒酵母		
<400> 62		
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gaggaacatg gcactgagtc tgttactgct attgctattg cctatgttcg ctctaaggcg 240		
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gctctcagta tcgatctaac gccggacaat ataaaatact tggaaaatgt agttcctttt 360		
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<210> 63		
<211> 312		
<212> PRT		
<213> 酿酒酵母		
<400> 63		
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Asn Asn Gly Tyr His Ser Val Ile Ala Ala Leu Lys Ala Gly Tyr Arg		
35 40 45		
His Ile Asp Ala Ala Ala Ile Tyr Leu Asn Glu Glu Glu Val Gly Arg		
50 55 60		
Ala Ile Lys Asp Ser Gly Val Pro Arg Glu Glu Ile Phe Ile Thr Thr		
65 70 75 80		
Lys Leu Trp Gly Thr Glu Gln Arg Asp Pro Glu Ala Ala Leu Asn Lys		
85 90 95		
Ser Leu Lys Arg Leu Gly Leu Asp Tyr Val Asp Leu Tyr Leu Met His		
100 105 110		
Trp Pro Val Pro Leu Lys Thr Asp Arg Val Thr Asp Gly Asn Val Leu		
115 120 125		

Cys Ile Pro Thr Leu Glu Asp Gly Thr Val Asp Ile Asp Thr Lys Glu
 130 135 140
 Trp Asn Phe Ile Lys Thr Trp Glu Leu Met Gln Glu Leu Pro Lys Thr
 145 150 155 160
 Gly Lys Thr Lys Ala Val Gly Val Ser Asn Phe Ser Ile Asn Asn Ile
 165 170 175
 Lys Glu Leu Leu Glu Ser Pro Asn Asn Lys Val Val Pro Ala Thr Asn
 180 185 190
 Gln Ile Glu Ile His Pro Leu Leu Pro Gln Asp Glu Leu Ile Ala Phe
 195 200 205
 Cys Lys Glu Lys Gly Ile Val Val Glu Ala Tyr Ser Pro Phe Gly Ser
 210 215 220
 Ala Asn Ala Pro Leu Leu Lys Glu Gln Ala Ile Ile Asp Met Ala Lys
 225 230 235 240
 Lys His Gly Val Glu Pro Ala Gln Leu Ile Ile Ser Trp Ser Ile Gln
 245 250 255
 Arg Gly Tyr Val Val Leu Ala Lys Ser Val Asn Pro Glu Arg Ile Val
 260 265 270
 Ser Asn Phe Lys Ile Phe Thr Leu Pro Glu Asp Asp Phe Lys Thr Ile
 275 280 285
 Ser Asn Leu Ser Lys Val His Gly Thr Lys Arg Val Val Asp Met Lys
 290 295 300
 Trp Gly Ser Phe Pro Ile Phe Gln
 305 310

<210> 64

<211> 939

<212> DNA

<213> 酿酒酵母

<400> 64

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 aagctttggg gtacggaaca acgtgatccg gaagctgctc taaacaagtc tttgaaaaga 300
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 gaatctccaa ataacaaggt ggtaccagct actaatcaaa ttgaaattca tccattgcta 600

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 ccatttggga gtgctaattgc tcctttacta aaagagcaag caattattga tatggctaaa 720
 aagcacggcg ttgagccagc acagcttatt atcagttgga gtattcaaag aggctacgtt 780
 gttctggcca aatcgggtta tcctgaaaga attgtatcca attttaagat tttcactctg 840
 cctgaggatg atttcaagac tattagtaac ctatccaaag tgcattggtac aaagagagtc 900
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<210> 65

<211> 353

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 65

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Phe	Glu	Val	Lys	Ile	Ile	Glu	Arg	Arg	Asp	Pro	Arg	Ala	Asp	Asp	Val
			20					25					30		
Val	Ile	Asp	Ile	Lys	Ala	Ala	Gly	Ile	Cys	His	Ser	Asp	Ile	His	Thr
		35					40					45			
Ile	Arg	Asn	Glu	Trp	Gly	Glu	Ala	His	Phe	Pro	Leu	Thr	Val	Gly	His
		50				55					60				
Glu	Ile	Ala	Gly	Val	Val	Ser	Ala	Val	Gly	Ser	Asp	Val	Thr	Lys	Trp
65			70						75					80	
Lys	Val	Gly	Asp	Arg	Val	Gly	Val	Gly	Cys	Leu	Val	Asn	Ser	Cys	Gly
			85					90						95	
Glu	Cys	Glu	Gln	Cys	Val	Ala	Gly	Phe	Glu	Asn	Asn	Cys	Leu	Arg	Gly
			100					105					110		
Asn	Val	Gly	Thr	Tyr	Asn	Ser	Asn	Asp	Val	Asp	Gly	Thr	Ile	Thr	Gln
		115						120				125			
Gly	Gly	Tyr	Ala	Glu	Lys	Val	Val	Val	Asn	Glu	Arg	Phe	Leu	Cys	Ser
		130				135					140				
Ile	Pro	Glu	Glu	Leu	Asn	Phe	Asp	Val	Ala	Ala	Pro	Leu	Leu	Cys	Ala
145				150						155				160	
Gly	Ile	Thr	Thr	Tyr	Ser	Pro	Ile	Ala	Arg	Trp	Asn	Val	Lys	Glu	Gly
			165						170					175	
Asp	Lys	Val	Ala	Val	Met	Gly	Leu	Gly	Gly	Leu	Gly	His	Met	Gly	Val
			180					185					190		
Gln	Ile	Ala	Ala	Ala	Lys	Gly	Ala	Glu	Val	Thr	Val	Leu	Ser	Arg	Ser
		195					200					205			
Leu	Arg	Lys	Ala	Glu	Leu	Ala	Lys	Glu	Leu	Gly	Ala	Ala	Arg	Thr	Leu
		210					215						220		

Ala Thr Ser Asp Glu Asp Phe Phe Thr Glu His Ala Gly Glu Phe Asp			
225	230	235	240
Phe Ile Leu Asn Thr Ile Ser Ala Ser Ile Pro Val Asp Lys Tyr Leu			
	245	250	255
Ser Leu Leu Lys Pro His Gly Val Met Ala Val Val Gly Leu Pro Pro			
	260	265	270
Glu Lys Gln Pro Leu Ser Phe Gly Ala Leu Ile Gly Gly Gly Lys Val			
	275	280	285
Leu Thr Gly Ser Asn Ile Gly Gly Ile Pro Glu Thr Gln Glu Met Leu			
	290	295	300
Asp Phe Cys Ala Lys His Gly Leu Gly Ala Met Ile Glu Thr Val Gly			
305	310	315	320
Val Asn Asp Val Asp Ala Ala Tyr Asp Arg Val Val Ala Gly Asp Val			
	325	330	335
Gln Phe Arg Val Val Ile Asp Thr Ala Ser Phe Ala Glu Val Glu Ala			
	340	345	350

Val

<210> 66

<211> 1062

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 66

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gtgagtatct cagtaaaagc actacaaaag tccggcccag aagcaccttt cgaggtcaag 60
atcattgaac gccgtgaccc acgcgagat gatgtggta ttgatatcaa agctgcgggc 120
atctgccaca gcgatatcca caccatccgc aacgaatggg gcgaggcgca cttcccgtc 180
accgtcggcc acgaaatcgc aggcgtgtgc tctgcggttg gatccgatgt aaccaaattgg 240
aaagtcggcg accgcgtggg cgtcggtgc ctcgttaact cctgcggcga atgcgaacag 300
tgcgtcgcag gatttgaaaa caactgcctt cgcggaaacg tcggaacctt caactctaac 360
gacgtcgacg gcaccatcac ccaaggcggc tacgtgaaa aggtagtggg caacgaacgt 420
ttcctgtgca gcatcccaga ggaacttaac ttgatgtcg cagcaccact gctgtgcgca 480
ggcatcacca cctactcccc aatcgctcgc tggaacgtta aagaaggcga caaagtagca 540
gtcatgggcc tcggcggact cggacacatg ggtgtccaga tcgctgcagc caagggtgct 600
gaggttaccg ttctgtcccc ttccctgcgc aaggcagaac ttgccaagga actcggcgca 660
gctcgcacgc ttgcgacttc tgatgaggat ttcttcaccg aacacgccg tgaattcgac 720
ttcatcctca acaccattag cgcattcatc ccagtcgaca agtacctgag ctttctcaag 780
ccacacgggtg tcatggctgt tgcggtctg ccaccagaga agcagccact gagcttcggt 840
gcgctcatcg gcggcggaac agtcctcacc ggatccaaca ttggcggcat ccctgaaacc 900
caggaaatgc tcgacttctg tgcaaaacac ggctcgggtg cgatgatcga aactgtcggc 960
gtcaacgatg ttgatgcagc ctacgaccgt gttgttgccg gcgacgttca gttccgcgtt 1020

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gtcattgata ctgcttcggt tgctgaggtt gaggcggttt ag 1062

<210> 67

<211> 368

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 67

Met	Ser	Thr	Val	Val	Pro	Gly	Ile	Val	Ala	Leu	Ser	Lys	Gly	Ala	Pro
1				5					10					15	
Val	Glu	Lys	Val	Asn	Val	Val	Val	Pro	Asp	Pro	Gly	Ala	Asn	Asp	Val
			20					25					30		
Ile	Val	Lys	Ile	Gln	Ala	Cys	Gly	Val	Cys	His	Thr	Asp	Leu	Ala	Tyr
		35					40					45			
Arg	Asp	Gly	Asp	Ile	Ser	Asp	Glu	Phe	Pro	Tyr	Leu	Leu	Gly	His	Glu
	50					55					60				
Ala	Ala	Gly	Ile	Val	Glu	Glu	Val	Gly	Glu	Ser	Val	Thr	His	Val	Glu
65					70				75					80	
Val	Gly	Asp	Phe	Val	Ile	Leu	Asn	Trp	Arg	Ala	Val	Cys	Gly	Glu	Cys
				85				90					95		
Arg	Ala	Cys	Lys	Lys	Gly	Glu	Pro	Lys	Tyr	Cys	Phe	Asn	Thr	His	Asn
			100					105					110		
Ala	Ser	Lys	Lys	Met	Thr	Leu	Glu	Asp	Gly	Thr	Glu	Leu	Ser	Pro	Ala
			115					120					125		
Leu	Gly	Ile	Gly	Ala	Phe	Leu	Glu	Lys	Thr	Leu	Val	His	Glu	Gly	Gln
			130					135					140		
Cys	Thr	Lys	Val	Asn	Pro	Glu	Glu	Asp	Pro	Ala	Ala	Ala	Gly	Leu	Leu
145					150					155				160	
Gly	Cys	Gly	Ile	Met	Ala	Gly	Leu	Gly	Ala	Ala	Val	Asn	Thr	Gly	Asp
				165					170					175	
Ile	Lys	Arg	Gly	Glu	Ser	Val	Ala	Val	Phe	Gly	Leu	Gly	Gly	Val	Gly
			180					185					190		
Met	Ala	Ala	Ile	Ala	Gly	Ala	Lys	Ile	Ala	Gly	Ala	Ser	Lys	Ile	Ile
			195					200					205		
Ala	Val	Asp	Ile	Asp	Glu	Lys	Lys	Leu	Glu	Trp	Ala	Lys	Glu	Phe	Gly
			210					215					220		
Ala	Thr	His	Thr	Ile	Asn	Ser	Ser	Gly	Leu	Gly	Gly	Glu	Gly	Asp	Ala
225					230				235					240	
Ser	Glu	Val	Val	Ala	Lys	Val	Arg	Glu	Leu	Thr	Asp	Gly	Phe	Gly	Thr
				245					250					255	
Asp	Val	Ser	Ile	Asp	Ala	Val	Gly	Ile	Met	Pro	Thr	Trp	Gln	Gln	Ala

260	265	270
Phe Tyr Ser Arg Asp His Ala Gly Arg Met Val Met Val Gly Val Pro		
275	280	285
Asn Leu Thr Ser Arg Val Asp Val Pro Ala Ile Asp Phe Tyr Gly Arg		
290	295	300
Gly Gly Ser Val Arg Pro Ala Trp Tyr Gly Asp Cys Leu Pro Glu Arg		
305	310	315
Asp Phe Pro Thr Tyr Val Asp Leu His Leu Gln Gly Arg Phe Pro Leu		
325	330	335
Asp Lys Phe Val Ser Glu Arg Ile Gly Leu Asp Asp Val Glu Glu Ala		
340	345	350
Phe Asn Thr Met Lys Ala Gly Asp Val Leu Arg Ser Val Val Glu Ile		
355	360	365

<210> 68

<211> 1107

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 68

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aacgttggtg tccctgatcc aggtgctaac gatgtcatcg tcaagattca ggcctgcggt 120
gtgtgccaca ccgacttggc ctaccgcgat ggcatatatt cagatgagtt cccttacctc 180
ctcggccacg aggcagcagg cattgttgag gaggtaggcg agtccgtcac ccacgttgag 240
gtcggcgatt tcgtcatctt gaactggcgt gcagtgtgcg gcgagtgccg tgcattgtaag 300
aagggcgagc caaagtactg cttaacacc cacaacgcct ctaagaagat gaccctggaa 360
gacggcaccg agctgtcccc agcactgggt attggcgcgt tcttgaaaaa gaccctggtc 420
cacgaaggcc agtgcaccaa ggtaaccct gaggaagatc cagcagcagc tggccttctg 480
ggttggtgca tcatggcagg ccttggcgct gcggtgaaca ccggtgatat taagcgtggc 540
gagtcgtag cagtcttcgg ccttgggtggc gtgggcatgg cagctattgc tggcgccaag 600
attgctggcg cttccaagat cattgctggt gatatcgatg agaagaagct ggagtggcg 660
aaggaattcg gcgcaaccca caccattaat tcctctggtc ttggtggcga aggtgatgcc 720
tctgaggtcg tggcaaaggt tcgtgagctc accgatgggt tcggcaccga tgtctccatc 780
gatgcgtag gcatcatgcc gacctggcag caggcgtttt actcccgtga ccatgcaggc 840
cgcatggtag tgggtggcgt tccaaacctg acgtctcgcg tagatgttcc tgcattgat 900
ttttacggtc gcggtggatc cgtgcgcctt gcatggtacg gcgactgcct gcctgagcgt 960
gatttcccaa cttatgtgga tctgcacctg cagggtcggt tcccactgga taagtttggt 1020
tctgagcgta ttggtcttga tgatgttgaa gaggttttca acaccatgaa ggctggcgac 1080
gtgctgcgtt ctgtggtgga gatctaa 1107

<210> 69

<211> 339

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 69

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Met Pro Lys Tyr Ile Ala Met Gln Val Ser Glu Ser Gly Ala Pro Leu
1           5           10           15
Ala Ala Asn Leu Val Gln Pro Ala Pro Leu Lys Ser Arg Glu Val Arg
           20           25           30
Val Glu Ile Ala Ala Ser Gly Val Cys His Ala Asp Ile Gly Thr Ala
           35           40           45
Ala Ala Ser Gly Lys His Thr Val Phe Pro Val Thr Pro Gly His Glu
           50           55           60
Ile Ala Gly Thr Ile Ala Glu Ile Gly Glu Asn Val Ser Arg Trp Thr
65           70           75           80
Val Gly Asp Arg Val Ala Ile Gly Trp Phe Gly Gly Asn Cys Gly Asp
           85           90           95
Cys Ala Phe Cys Arg Ala Gly Asp Pro Val His Cys Arg Glu Arg Lys
           100          105          110
Ile Pro Gly Val Ser Tyr Ala Gly Gly Trp Ala Gln Asn Ile Val Val
           115          120          125
Pro Ala Glu Ala Leu Ala Ala Ile Pro Asp Gly Met Asp Phe Tyr Glu
           130          135          140
Ala Ala Pro Met Gly Cys Ala Gly Val Thr Thr Phe Asn Ala Leu Arg
145          150          155          160
Asn Leu Lys Leu Asp Pro Gly Ala Ala Val Ala Val Phe Gly Ile Gly
           165          170          175
Gly Leu Val Arg Leu Ala Ile Gln Phe Ala Ala Lys Met Gly Tyr Arg
           180          185          190
Thr Ile Thr Ile Ala Arg Gly Leu Glu Arg Glu Glu Leu Ala Arg Gln
           195          200          205
Leu Gly Ala Asn His Tyr Ile Asp Ser Asn Asp Leu His Pro Gly Gln
           210          215          220
Ala Leu Phe Glu Leu Gly Gly Ala Asp Leu Ile Leu Ser Thr Ala Ser
225          230          235          240
Thr Thr Glu Pro Leu Ser Glu Leu Ser Thr Gly Leu Ser Ile Gly Gly
           245          250          255
Gln Leu Thr Ile Ile Gly Val Asp Gly Gly Asp Ile Thr Val Ser Ala
           260          265          270
Ala Gln Leu Met Met Asn Arg Gln Ile Ile Thr Gly His Leu Thr Gly
           275          280          285

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Ser Ala Asn Asp Thr Glu Gln Thr Met Lys Phe Ala His Leu His Gly
 290 295 300
 Val Lys Pro Leu Ile Glu Arg Met Pro Leu Asp Gln Ala Asn Glu Ala
 305 310 315 320
 Ile Ala Arg Ile Ser Ala Gly Lys Pro Arg Phe Arg Ile Val Leu Glu
 325 330 335

Pro Asn Ser

<210> 70

<211> 1020

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 70

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 gtgcaacctg ctccgttgaa atcgagggaa gtccgcgtgg aaatcgctgc tagtggtgtg 120
 tgccatgcag atattggcac ggcagcagca tcggggaagc aactgtttt tcctgttacc 180
 cctggtcatg agattgcagg aaccatcgcg gaaattggtg aaaacgtatc tcggtggacg 240
 gttggtgatc gcgttgcaat cggttggttt gttggcaatt gcggtgactg cgctttttgt 300
 cgtgcagggtg atcctgtgca ttgcagagag cggaagattc ctggcgtttc ttatgcgggt 360
 ggttgggcac agaataattgt tgttccagcg gaggtctttg ctgcgattcc agatggcatg 420
 gactttttacg aggccgcccc gatgggctgc gcaggtgtga caacattcaa tgcgttgcca 480
 aacctgaagc tggatcccgg tgcggctgtc gcggtctttg gaatcggcgg ttagtgccgc 540
 ctagctattc agtttgctgc gaaaatgggt tatcgaacca tcaccatcgc ccgcggttta 600
 gagcgtgagg agctagctag gcaacttggc gccaaccact acatcgatag caatgatctg 660
 caccctggcc aggcgttatt tgaacttggc ggggctgact tgatcttgtc tactgcgtcc 720
 accacggagc ctctttcggg gttgtctacc ggtctttcta ttggcgggca gtaaccatt 780
 atcggagttg atgggggaga tatcaccgtt tcggcagccc aattgatgat gaaccgtcag 840
 atcatcacag gtcacctcac tggaagtgcg aatgacacgg aacagactat gaaatttgct 900
 catctccatg gcgtgaaacc gcttattgaa cggatgcctc tcgatcaagc caacgaggct 960
 attgcacgta tttcagctgg taaaccacgt ttccgtattg tcttgagacc gaattcataa 1020

<210> 71

<211> 345

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 71

Met Thr Thr Ala Ala Pro Gln Glu Phe Thr Ala Ala Val Val Glu Lys
 1 5 10 15
 Phe Gly His Asp Val Thr Val Lys Asp Ile Asp Leu Pro Lys Pro Gly
 20 25 30
 Pro His Gln Ala Leu Val Lys Val Leu Thr Ser Gly Ile Cys His Thr

	35				40				45								
Asp	Leu	His	Ala	Leu	Glu	Gly	Asp	Trp	Pro	Val	Lys	Pro	Glu	Pro	Pro		
	50				55				60								
Phe	Val	Pro	Gly	His	Glu	Gly	Val	Gly	Glu	Val	Val	Glu	Leu	Gly	Pro		
65					70				75						80		
Gly	Glu	His	Asp	Val	Lys	Val	Gly	Asp	Ile	Val	Gly	Asn	Ala	Trp	Leu		
				85				90						95			
Trp	Ser	Ala	Cys	Gly	Thr	Cys	Glu	Tyr	Cys	Ile	Thr	Gly	Arg	Glu	Thr		
		100				105				110							
Gln	Cys	Asn	Glu	Ala	Glu	Tyr	Gly	Gly	Tyr	Thr	Gln	Asn	Gly	Ser	Phe		
	115				120				125								
Gly	Gln	Tyr	Met	Leu	Val	Asp	Thr	Arg	Tyr	Ala	Ala	Arg	Ile	Pro	Asp		
	130				135				140								
Gly	Val	Asp	Tyr	Leu	Glu	Ala	Ala	Pro	Ile	Leu	Cys	Ala	Gly	Val	Thr		
145				150				155						160			
Val	Tyr	Lys	Ala	Leu	Lys	Val	Ser	Glu	Thr	Arg	Pro	Gly	Gln	Phe	Met		
		165				170				175							
Val	Ile	Ser	Gly	Val	Gly	Gly	Leu	Gly	His	Ile	Ala	Val	Gln	Tyr	Ala		
	180				185				190								
Ala	Ala	Met	Gly	Met	Arg	Val	Ile	Ala	Val	Asp	Ile	Ala	Asp	Asp	Lys		
	195				200				205								
Leu	Glu	Leu	Ala	Arg	Lys	His	Gly	Ala	Glu	Phe	Thr	Val	Asn	Ala	Arg		
	210				215				220								
Asn	Glu	Asp	Ser	Gly	Glu	Ala	Val	Gln	Lys	Tyr	Thr	Asn	Gly	Gly	Ala		
225				230				235						240			
His	Gly	Val	Leu	Val	Thr	Ala	Val	His	Glu	Ala	Ala	Phe	Gly	Gln	Ala		
		245				250				255							
Leu	Asp	Met	Ala	Arg	Arg	Ala	Gly	Thr	Ile	Val	Phe	Asn	Gly	Leu	Pro		
	260				265				270								
Pro	Gly	Glu	Phe	Pro	Ala	Ser	Val	Phe	Asn	Ile	Val	Phe	Lys	Gly	Leu		
	275				280				285								
Thr	Ile	Arg	Gly	Ser	Leu	Val	Gly	Thr	Arg	Gln	Asp	Leu	Ala	Glu	Ala		
	290				295				300								
Leu	Asp	Phe	Phe	Ala	Arg	Gly	Leu	Ile	Lys	Pro	Thr	Val	Ser	Glu	Cys		
305				310				315						320			
Ser	Leu	Asp	Glu	Val	Asn	Gly	Val	Leu	Asp	Arg	Met	Arg	Asn	Gly	Lys		
		325				330				335							
Ile	Asp	Gly	Arg	Val	Ala	Ile	Arg	Phe									
	340				345												

<210> 72

<211> 1038

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 72

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gtgaccgtga aggatattga ccttccaaag ccagggccac accaggcatt ggtgaaggta 120
ctcacctccg gcatctgcc aaccgacctc cacgccttgg agggcgattg gccagtaaag 180
ccggaaccac cattcgtacc aggacacgaa ggtgtaggtg aagttgttga gctcggacca 240
ggtgaacacg atgtgaaggt cggcgatatt gtcggcaatg cgtggctctg gtcagcgtgt 300
ggcacctgcg aatactgcat caccggcagg gaaactcagt gcaacgaagc tgagtatggt 360
ggctacaccc aaaatggatc cttcggccag tacatgctgg tggatacccg ttacgccgct 420
cgcacccag acggcgtgga ctacctcgaa gcagcaccaa ttctgtgtgc aggcgtgact 480
gtctacaagg cactcaaagt ctctgaaacc cgccccggcc aattcatggt gatctccggt 540
gtcggcggac ttggccacat cgcagtccaa tacgcagcgg cgatgggcat gcgtgtcatt 600
gcggtagata ttgccgatga caagctggaa cttgcccgt aagcacggtgc ggaatttacc 660
gtgaatgcgc gtaatgaaga ttcaggcgaa gctgtacaga agtacaccaa cgggtggcgca 720
cacggcgtgc ttgtgactgc agttcacgag gcagcattcg gccaggcact ggatatggct 780
cgacgtgcag gaacaattgt gttcaacggt ctgccaccgg gagagttccc agcatccgtg 840
ttcaacatcg tattcaaggg cctgaccatc cgtggatccc tcgtgggaac ccgccaagac 900
ttggccgaag cgctcgattt ctttgcacgc ggactaatca agccaaccgt gagtgagtgc 960
tcctctgatg aggtcaatgg tgtgcttgac cgcatgcgaa acggcaagat cgatggtcgt 1020
gtggcgattc gtttctaa 1038

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<210> 73

<211> 356

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 73

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Met Ser Leu Gln Phe Asp His Glu Thr Leu Gly Gln Arg Val Leu Phe
1           5           10           15
Gly Ser Gly Glu Ala Ala Gln Asn Leu Ala Ala Glu Ile Ser Arg Leu
          20           25           30
Asp Ala Lys Asn Val Met Val Val Ala Gly Asp Phe Glu Leu Pro Met
          35           40           45
Ala Arg Gln Val Ala Ala Asp Ile Asp Val Lys Val Trp His Ser Asn
          50           55           60
Val Val Met His Val Pro Ile Glu Thr Ala Glu Glu Ala Arg Ser Val
65           70           75           80
Ala Lys Glu Asn Asp Ile Asp Val Val Val Cys Val Gly Gly Gly Ser

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	85		90		95
Thr Thr Gly Leu Ala Lys Ala Ile Ala Met Thr Thr Ala Leu Pro Ile					
100		105		110	
Ile Ala Val Pro Thr Thr Tyr Ala Gly Ser Glu Ala Thr Asn Val Trp					
115		120		125	
Gly Leu Thr Glu Ala Ala Arg Lys Thr Thr Gly Val Asp Asn Lys Val					
130		135		140	
Leu Pro Val Thr Val Ile Tyr Asp Ser Ala Leu Thr Met Ser Leu Pro					
145		150		155	
Val Glu Met Ser Val Ala Ser Gly Leu Asn Gly Leu Ala His Cys Ile					
165		170		175	
Asp Ser Leu Trp Gly Pro Lys Ala Asp Pro Ile Asn Ala Ala Met Ala					
180		185		190	
Ala Glu Gly Ile Arg Ala Leu Ser Ala Gly Leu Pro Lys Ile Val Ala					
195		200		205	
Asp Ala Gln Asp Val Asp Gly Arg Asp Glu Ala Leu Tyr Gly Ala Tyr					
210		215		220	
Leu Ala Ala Val Ser Phe Ala Ser Ala Gly Ser Gly Leu His His Lys					
225		230		235	
Ile Cys His Val Leu Gly Gly Thr Phe Asn Leu Pro His Ala Gln Thr					
245		250		255	
His Ala Thr Val Leu Pro Tyr Val Leu Ala Phe Asn Ala Pro Tyr Ala					
260		265		270	
Pro Gln Ala Glu Gln Arg Ala Ala Ala Phe Gly Ser Ala Thr Ala					
275		280		285	
Leu Glu Gly Leu Gln Gln Leu Arg Ala Gln Val Gly Ala Pro Gln Arg					
290		295		300	
Leu Ser Asp Tyr Gly Phe Thr Ala Ala Gly Ile Pro Glu Ala Val Glu					
305		310		315	
Ile Ile Leu Glu Lys Val Pro Ala Asn Asn Pro Arg Thr Val Thr Glu					
325		330		335	
Glu Asn Leu Thr Ala Leu Leu Thr Thr Ala Leu Asn Gly Asp Asp Pro					
340		345		350	
Ala Thr Leu Asn					
355					

<210> 74

<211> 1071

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 74

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 gccggtgatt tcgagcttcc catggcacgg caagtagcag cagatattga tgtcaaggtg 180
 tggcattcaa atgtcgtgat gcatgtgcc atcgaaacag cagaagaagc acgcagtgtt 240
 gcgaaagaaa acgacattga tgttgtggtg tgtgtgggcg gtggatccac aacaggtcta 300
 gctaaagcga ttgccatgac caccgcattg ccgatcattg cggtaaccac tacttatgca 360
 ggttctgaag caacaaatgt gtggggattg accgaagccg cgcgcaaaac aactggtgtt 420
 gataacaaaag tgctgccagt gacagttatc tacgattcag cgtaaccat gtctttgccg 480
 gtagaaatgt cggttgcttc tggctcfaat ggtttggtc actgcattga ttctttgtgg 540
 ggaccgaagg cggatcccat caatgcggt atggctgctg aggaattcg agcactttct 600
 gctggccttc ccaagattgt ggcatgtgt caggacgtag atggtcgca tgaagcgctc 660
 tacggtgcct acctggctgc ggtgtctttt gcctctgctg gctctggtct ccaccacaag 720
 atctgccacg tgttgggtgg aacttttaac cttccacacg cgcaaaccca tgcaacagta 780
 ctgccttatg ttcttgctt caacgcgcca tatgcgccac aggcagaaca acgcgcagcg 840
 gcagctttcg gttctgcgac agcacttgaa ggattgcaac agctgcgtgc ccaagtggga 900
 gcaccacagc gactatccga ttacggattc accgcagcag gaatcccaga ggcagtggaa 960
 atcatcttgg agaaagtacc ggcaataat ccacggacgg tcacagaaga aaacctcact 1020
 gcgctgctta ccacagcgct caacggcgac gatccagcaa ctttgaatta a 1071

<210> 75

<211> 292

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 75

Met Gln Thr Leu Ala Ala Ile Val Arg Ala Thr Lys Gln Pro Phe Glu
 1 5 10 15
 Ile Thr Thr Ile Asp Leu Asp Ala Pro Arg Pro Asp Glu Val Gln Ile
 20 25 30
 Arg Val Ile Ala Ala Gly Val Arg His Thr Asp Ala Ile Val Arg Asp
 35 40 45
 Gln Ile Tyr Pro Thr Phe Leu Pro Ala Val Phe Gly His Glu Gly Ala
 50 55 60
 Gly Val Val Val Ala Val Gly Ser Ala Val Thr Ser Val Lys Pro Asp
 65 70 75 80
 Asp Lys Val Val Leu Gly Phe Asn Ser Cys Gly Gln Cys Leu Lys Cys
 85 90 95
 Leu Gly Gly Lys Pro Ala Tyr Cys Glu Lys Phe Tyr Asp Arg Asn Phe
 100 105 110
 Ala Cys Thr Arg Asp Ala Gly His Thr Thr Leu Phe Thr Arg Ala Thr

115	120	125
Lys Glu Gln Ala Glu Ala Ile Ile Asp Thr Leu Asp Asp Val Phe Tyr		
130	135	140
Asp Ala Asp Ala Gly Phe Leu Ala Tyr Pro Ala Thr Pro Pro Glu Ala		
145	150	155
Ser Gly Val Ser Val Leu Val Val Ala Ala Gly Thr Ser Asp Leu Pro		
165	170	175
Gln Ala Lys Glu Ala Leu His Thr Ala Ser Tyr Leu Gly Arg Ser Thr		
180	185	190
Ser Leu Ile Val Asp Phe Gly Val Ala Gly Ile His Arg Leu Leu Ser		
195	200	205
Tyr Glu Glu Glu Leu Arg Ala Ala Gly Val Leu Ile Val Ala Ala Gly		
210	215	220
Met Asp Gly Ala Leu Pro Gly Val Val Ala Gly Leu Val Ser Ala Pro		
225	230	235
Val Val Ala Leu Pro Thr Ser Val Gly Tyr Gly Ala Gly Ala Gly Gly		
245	250	255
Ile Ala Pro Leu Leu Thr Met Leu Asn Ala Cys Ala Pro Gly Val Gly		
260	265	270
Val Val Asn Ile Asp Asn Gly Tyr Gly Ala Gly His Leu Ala Ala Gln		
275	280	285
Ile Ala Ala Arg		
290		

<210> 76

<211> 879

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 76

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cacactgacg caattgttcg tgatcagatt tacccaactt ttcttccgc agttttcggc 180
cacgaaggcg ccggagtagt tgtcgccgtg ggttctgcag tcacctcggg gaaaccagat 240
gacaaggtag tgctgggatt caactcttgt ggccagtgt tgaagtgtt gggcggtaag 300
cctgcgtact gtgagaaatt ctatgaccgc aacttcgcat gcacccgcga tgccgggcac 360
actactttgt ttacccgtgc aacaaaagag caggcagagg ccatcatcga cacccttgat 420
gatgttttct acgatgcgga tgcgggtttc ctggcatacc cagcaactcc ccagaggct 480
tcgggagtaa gcgtgttgg tgtcgcggct ggtacctctg atctcccca agcaaaggaa 540
gcactacaca ctgcctccta cttggggcgc tccacctcac tgattgttga ttttgagtg 600
gctggcatcc accgcctgct ttcatacgaa gaagaactcc gcgctgcggg cgtgctcatc 660

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gttgccgctg gaatggatgg tgcgctaccc ggagttgtcg caggcttagt gtccgcacct 720
 gtcgtcgcac tgccaacctc cgtgggatac ggcgaggtg ctggaggaat cgcaccactt 780
 ctgaccatgc ttaacgcctg cgcgccggga gttggagtgg tcaacattga taacggctat 840
 ggagcaggac acctggctgc gcagattgcg gcgaggtaa 879

<210> 77

<211> 253

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 77

Met	Leu	Asn	Ala	Val	Gly	Lys	Ala	Gln	Asn	Ile	Leu	Leu	Leu	Gly	Gly	1	5	10	15
Thr	Ser	Glu	Ile	Gly	Ile	Ser	Ile	Val	Ser	Arg	Phe	Leu	Lys	Gln	Gly	20	25	30	
Pro	Ser	His	Val	Thr	Leu	Ala	Ala	Arg	Lys	Asp	Ser	Pro	Arg	Val	Asp	35	40	45	
Ala	Ala	Val	Ala	Glu	Ile	Lys	Ala	Ala	Gly	Ala	Ala	Ser	Val	Ala	Val	50	55	60	
Val	Asp	Phe	Asp	Ala	Leu	Asp	Thr	Glu	Ser	His	Pro	Ala	Ala	Ile	Asp	65	70	75	80
Ala	Ala	Phe	Glu	Asn	Gly	Asp	Val	Asp	Val	Ala	Ile	Val	Ala	Phe	Gly	85	90	95	
Ile	Leu	Gly	Asp	Asn	Glu	Ala	Gln	Trp	Arg	Asp	Gln	Ala	Leu	Ala	Val	100	105	110	
Glu	Ala	Thr	Thr	Val	Asn	Tyr	Thr	Ala	Gly	Val	Ser	Val	Gly	Val	Leu	115	120	125	
Leu	Gly	Gln	Lys	Phe	Glu	Gln	Gln	Gly	His	Gly	Thr	Ile	Val	Ala	Leu	130	135	140	
Ser	Ser	Val	Ala	Gly	Gln	Arg	Val	Arg	Arg	Ser	Asn	Phe	Val	Tyr	Gly	145	150	155	160
Ser	Ala	Lys	Ala	Gly	Phe	Asp	Gly	Phe	Tyr	Thr	Gln	Leu	Gly	Glu	Ala	165	170	175	
Leu	Arg	Gly	Ser	Gly	Ala	Asn	Val	Leu	Val	Val	Arg	Pro	Gly	Gln	Val	180	185	190	
Arg	Thr	Lys	Met	Ser	Ala	Asp	Gly	Gly	Glu	Ala	Pro	Leu	Thr	Val	Asn	195	200	205	
Arg	Glu	Asp	Val	Ala	Asp	Ala	Val	Tyr	Asp	Ala	Val	Val	Asn	Lys	Lys	210	215	220	
Asp	Ile	Ile	Phe	Val	His	Pro	Leu	Phe	Gln	Tyr	Val	Ser	Phe	Ala	Phe	225	230	235	240

Gln Phe Ile Pro Arg Ala Ile Phe Arg Lys Leu Pro Phe

245

250

<210> 78

<211> 762

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 78

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cgtaaagatt cccacgcgt ggacgcagca gtcgcagaga tcaaagcagc tggcgctgct 180
tccgttgctg ttgttgattt cgatgcgctc gacaccgaat cccaccctgc agccatcgac 240
gcagcctttg aaaacggcga cgttgacgta gcaatcgtgg ctttcggcat cctcggcgac 300
aacgaagcac agtggcgcgga ccaagcacta gcagtggaag caaccaccgt gaactacacc 360
gccggcgttt ccgtaggtgt actgctgggc cagaaatttg agcagcaggg ccacggcacc 420
atcgtggcat tgtcctctgt ggacggccag cgagtccgcc gctccaactt tgtctacggc 480
tccgccaagg caggtttcga cgttttctac acccagctcg gcgaagccct gcgtggatcc 540
ggtgccaacg tattggtggt tcgcccaggc caggtacgca ccaagatgtc cgcagatggt 600
ggcgaagccc cactgaccgt caaccgcgaa gacgtggcag atgctgttta tgatgcagtg 660
gtgaacaaga aggacatcat ctttgtccac ccactgttcc agtacgtctc ttttgcgttc 720
caattcattc cgcgagcaat cttccgcaag ctgccgttct aa 762
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<210> 79

<211> 315

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 79

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1           5           10          15
Pro Leu Asn Leu Gly Gly Asn Thr Phe Gly Trp Thr Ser Asn Arg Glu
          20          25          30
Gln Thr Phe Ala Val Leu Asp Ala Phe Val Ala Ala Gly Gly Asn Phe
          35          40          45
Val Asp Thr Ala Asp Ser Tyr Ser Ala Trp Val Glu Gly Asn Glu Gly
          50          55          60
Gly Glu Ser Glu Arg Glu Leu Gly Ala Trp Ile Lys Glu Arg Gly Ala
65          70          75          80
Asp Lys Leu Ile Ile Ala Thr Lys Ser Gly Ala Leu Glu Pro Val Ala
          85          90          95
Gly Arg Ser Arg Glu Ala Thr Phe Lys Ala Val Glu Gly Ser Leu Glu
          100         105         110
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Arg Leu Gly Val Glu Ser Ile Asp Ile Phe Tyr Tyr His Tyr Asp Asp		
115	120	125
Glu Ala Val Ser Ile Asp Glu Gln Val Ala Ile Ala Asn Asp Leu Ile		
130	135	140
Ala Gln Gly Lys Ile Lys His Leu Ala Leu Ser Asn Tyr Ser Ala Glu		
145	150	155
Arg Leu Ala Glu Phe Phe Glu Lys Ser Val Gly Thr Pro Ala Gln Pro		
165	170	175
Val Ala Leu Gln Pro His Tyr Asn Leu Val Ser Arg Lys Asp Tyr Glu		
180	185	190
Glu Asn Val Gln Pro Leu Ala Glu Lys His Gly Val Ala Val Phe Pro		
195	200	205
Tyr Phe Ala Leu Ala Ala Gly Leu Leu Thr Gly Lys Tyr Thr Ser Lys		
210	215	220
Glu Asp Ile Ser Gly Lys Ala Arg Ala Gly Gln Leu Asp Arg Tyr Ala		
225	230	235
Ser Asp Glu Ala Phe Ala Val Val Thr Glu Leu Arg Ala Val Ala Asp		
245	250	255
Glu Leu Gly Val Ala Pro Thr Thr Val Ala Leu Ala Trp Leu Val Ala		
260	265	270
His Gly Val Thr Ala Pro Ile Ala Ser Val Ser Lys Val Glu Gln Leu		
275	280	285
Lys Asp Leu Met Ala Val Lys Asp Val Glu Leu Ser Ala Glu Gln Leu		
290	295	300
Ala Arg Leu Asp Lys Val Ser Glu Pro Phe Ala		
305	310	315

<210> 80

<211> 948

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 80

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ttcgtggcag cgggaggaaa ctttgttgac accgccgatt cttattctgc atgggttgaa 180
ggcaatgagg gtggcgagtc ggagcgggag ctcggcgcgt ggattaagga acgtggcgca 240
gacaagctga tcattgctac caagtctggt gcgttgagac ctgttgctgg tcgttcccgt 300
gaggcaactt tcaaggctgt cgagggttcc ctggagcgtt tgggcgtgga atcgatcgat 360
atgttttact accactacga cgatgaggca gtcagcattg atgagcaggt tgctatcgct 420
aatgatctga ttgcacaggg caagattaag cacctcgcat tgtctaacta cagcgcggag 480

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cgtttagctg agttctttga gaagtctgta ggcactccag cgcagccggt tgctctgcaa 540
 ccgcactaca acctggtgtc gaggaaggat tatgaggaga acgtgcagcc actcgccgag 600
 aagcatggcg ttgcagtcctt cccttatttc gcgcttgccg cgggtctttt gaccggaaag 660
 tacacctcca aggaggatat ttcgggtaaa gcgcgtgcgg ggcagttgga tcgttacgcc 720
 agcgaatgagg cgtttgccgt ggtgacagag ttgcgtgctg ttgccgatga gttgggtggt 780
 gcgccaacga ctgtggcgct tgcgtggttg gttgcgcatg gtgtgaccgc accgattgcg 840
 tccgtgtcca aggtagagca gttgaaggat ttgatggctg tgaaggatgt ggagctgagc 900
 gctgagcagc ttgcacgttt ggataagggt tcggagcctt tcgcttaa 948

<210> 81

<211> 363

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 81

Met	Asn	Asn	Ser	Leu	Ala	Phe	Asn	His	Asp	Thr	Leu	Pro	Gln	Lys	Val
1				5					10					15	
Met	Phe	Gly	Tyr	Gly	Lys	Ser	Ser	Ala	Phe	Leu	Lys	Gln	Glu	Val	Glu
				20				25					30		
Arg	Arg	Gly	Ser	Ala	Lys	Val	Met	Val	Ile	Ala	Gly	Glu	Arg	Glu	Met
				35				40					45		
Ser	Ile	Ala	His	Lys	Val	Ala	Ser	Glu	Ile	Glu	Val	Ala	Ile	Trp	His
				50				55				60			
Asp	Glu	Val	Val	Met	His	Val	Pro	Ile	Glu	Val	Ala	Glu	Arg	Ala	Arg
65				70				75				80			
Ala	Val	Ala	Thr	Asp	Asn	Glu	Ile	Asp	Leu	Leu	Val	Cys	Val	Gly	Gly
				85				90				95			
Gly	Ser	Thr	Ile	Gly	Leu	Ala	Lys	Ala	Ile	Ala	Met	Thr	Thr	Ala	Leu
				100				105				110			
Pro	Ile	Val	Ala	Ile	Pro	Thr	Thr	Tyr	Ala	Gly	Ser	Glu	Ala	Thr	Asn
				115				120				125			
Val	Trp	Gly	Leu	Thr	Glu	Ala	Ala	Arg	Lys	Thr	Thr	Gly	Val	Asp	Leu
				130				135				140			
Lys	Val	Leu	Pro	Glu	Thr	Val	Ile	Tyr	Asp	Ser	Glu	Leu	Thr	Met	Ser
145				150				155				160			
Leu	Pro	Val	Glu	Met	Ser	Val	Ala	Ser	Gly	Leu	Asn	Gly	Leu	Ala	His
				165				170				175			
Cys	Ile	Asp	Ser	Leu	Trp	Gly	Pro	Asn	Ala	Asp	Pro	Ile	Asn	Ala	Val
				180				185				190			
Leu	Ala	Ala	Glu	Gly	Ile	Arg	Ala	Leu	Asn	Gln	Gly	Leu	Pro	Lys	Ile
				195				200				205			

Val Ala Asn Pro His Ser Ile Glu Gly Arg Asp Glu Ala Leu Tyr Gly		
210	215	220
Ala Tyr Leu Ala Ala Val Ser Phe Ala Ser Ala Gly Ser Gly Leu His		
225	230	235 240
His Lys Ile Cys His Thr Leu Gly Gly Thr Phe Asn Leu Pro His Ala		
	245	250 255
Gln Thr His Ala Thr Val Leu Pro Tyr Val Leu Ala Phe Asn Ala Gly		
	260	265 270
Asp Ala Pro Glu Ala Glu Arg Arg Ala Ala Ala Phe Gly Thr Asp		
	275	280 285
Thr Ala Leu Glu Gly Leu Gln Arg Leu Arg Leu Ser Val Asn Ala Pro		
	290	295 300
Lys Arg Leu Ser Asp Tyr Gly Phe Glu Ala Ser Gly Ile Ala Glu Ala		
305	310	315 320
Val Asp Val Thr Leu Glu Lys Val Pro Ala Asn Asn Pro Arg Pro Val		
	325	330 335
Thr Arg Glu Asn Leu Ser Arg Leu Leu Glu Ala Ala Leu Asn Gly Glu		
	340	345 350
Asp Pro Ala Val Leu Ser Ala Val Leu Ser Asn		
	355	360

<210> 82

<211> 1092

<212> DNA

<213> 谷氨酸棒状杆菌

<400> 82

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gtcattgcgg gtgaacgaga aatgtcgatc gcccataagg tggcctcaga aattgaggtg 180
gcgatctggc acgacgaagt tgtcatgcac gtgcccacgc aagtagccga acgtgcgcgt 240
gcagtggcaa ccgacaatga gattgatctg ctgggtgtgtg ttggcggcgg atccaccata 300
ggttttggcca aagcaattgc catgaccact gccctgccc tegtgcgat cccaccacc 360
tacgcaggat cggaagcaac caacgtgtgg ggtctgacgg aagcagcgcg caaaacaacc 420
ggtgttgatc tgaaggtgct ccccgaaaca gtcatttacg attccgaact caccatgtcg 480
cttccagtgg agatgtccgt ggcatccgga ctcaacggcc tggcgactg cattgattct 540
ttgtggggac ccaacgccga tcccatcaac gcagtgttg cagccgaagg aatccgcgca 600
ctcaaccagg gactgccgaa aattgttgcg aaccgcaca gcatcgaagg acgcgacgaa 660
gccctctacg gcgcctacct cgcagcagta tccttcgcct ccgcaggctc cgactacac 720
cacaaaatct gccacacctt gggaggcacc ttcaacctcc cccacgcca aaccacgca 780
accgtgctgc cgtatgtttt ggcattcaac gcaggcgacg caccagaagc tgaacgccgc 840

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gcagccgcag cctttggaac tgacaccgca ctagaaggcc tgcaacgcct ccgcttgtca 900
gtcaacgcac cgaaacgact ttccgactac ggcttcgagg cttcaggaat tgctgaggca 960
gtggacgtca cgttggagaa agttcccgcc aacaatcctc gcccagtgac ccgggaaaac 1020
ctcagcagat tgctcgaagc agcactcaac ggtgaggatc cggcagttct tagcgcagta 1080
ctcagtaact aa 1092

<210> 83

<211> 316

<212> PRT

<213> 谷氨酸棒状杆菌

<400> 83

Met	Lys	Gln	Arg	Met	Val	Gly	Ser	Ser	Gly	Leu	Arg	Val	Ser	Arg	Leu
1				5					10					15	
Gly	Leu	Gly	Thr	Ser	Thr	Trp	Gly	Ser	Gly	Thr	Glu	Leu	Ala	Glu	Ala
			20					25					30		
Gly	Asp	Ile	Phe	Lys	Ala	Phe	Ile	Asn	Ser	Gly	Gly	Thr	Leu	Ile	Asp
		35					40					45			
Val	Ser	Pro	Asn	Tyr	Thr	Thr	Gly	Val	Ala	Glu	Glu	Met	Leu	Gly	Thr
	50					55					60				
Met	Leu	Asp	Ala	Glu	Val	Ser	Arg	Ser	Ala	Val	Val	Ile	Ser	Ser	Ser
65				70					75					80	
Ala	Gly	Val	Asn	Pro	Ala	Leu	Pro	Leu	Gly	Arg	Arg	Val	Asp	Cys	Ser
			85						90				95		
Arg	Arg	Asn	Leu	Ile	Ala	Gln	Leu	Asp	Val	Thr	Leu	Arg	Ala	Leu	Asn
		100						105					110		
Thr	Asp	Tyr	Leu	Asp	Leu	Trp	Ser	Val	Gly	Tyr	Trp	Asp	Glu	Gly	Thr
	115						120					125			
Pro	Pro	His	Glu	Val	Ala	Asp	Thr	Leu	Asp	Tyr	Ala	Val	Arg	Thr	Gly
	130					135					140				
Arg	Val	Arg	Tyr	Ala	Gly	Val	Arg	Gly	Tyr	Ser	Gly	Trp	Gln	Leu	Ala
145				150					155					160	
Val	Thr	His	Ala	Ala	Ser	Asn	His	Ala	Ala	Ala	Ser	Ala	Arg	Pro	Val
			165						170				175		
Val	Val	Ala	Gln	Asn	Glu	Tyr	Ser	Leu	Leu	Glu	Arg	Arg	Ala	Glu	Gln
		180						185				190			
Glu	Leu	Leu	Pro	Ala	Thr	Gln	His	Leu	Gly	Val	Gly	Phe	Phe	Ala	Gly
	195					200					205				
Ala	Pro	Leu	Gly	Gln	Gly	Val	Leu	Thr	Ala	Lys	Tyr	Arg	Ser	Glu	Ile
	210					215					220				
Pro	His	Asp	Ser	Arg	Ala	Ala	Ser	Thr	Gly	Arg	Asp	Ala	Glu	Val	Gln

15

Val	Gln	Asp	Val	Pro	Ser	Thr	Lys	Pro	Gly	Tyr	Gly	Glu	Val	Lys	Val
20				25				30							
Lys	Leu	Lys	Ser	Ala	Gly	Leu	Asn	His	Arg	Asp	Leu	Phe	Leu	Met	Lys
35				40				45							
Asn	Lys	Ser	Glu	Gln	Asp	Pro	His	Met	Ile	Leu	Gly	Ser	Asp	Gly	Ala
50				55				60							
Gly	Ile	Ile	Glu	Glu	Ile	Gly	Glu	Gly	Val	Lys	Asn	Val	Thr	Val	Gln
65				70				75				80			
Thr	Glu	Val	Val	Ile	Phe	Pro	Thr	Leu	Asn	Trp	Asp	Leu	Thr	Glu	Asn
85				90				95							
Val	Pro	Pro	Val	Pro	Glu	Ile	Leu	Gly	Gly	Pro	Ser	Asp	Gly	Thr	Leu
100				105				110							
Ala	Glu	Tyr	Val	Ile	Ile	Pro	Ser	Gln	Asn	Ala	Ile	Lys	Lys	Pro	Ala
115				120				125							
Tyr	Leu	Ser	Trp	Glu	Glu	Ala	Gly	Val	Leu	Pro	Leu	Ser	Ala	Leu	Thr
130				135				140							
Ala	Tyr	Arg	Ala	Leu	Phe	Thr	Lys	Gly	Gln	Leu	Lys	Lys	Gly	Glu	His
145				150				155				160			
Leu	Leu	Ile	Pro	Gly	Ile	Gly	Ser	Gly	Val	Ala	Thr	Tyr	Ala	Leu	Phe
165				170				175							
Met	Ala	Lys	Ala	Ile	Gly	Ala	Thr	Val	Ser	Val	Thr	Ser	Arg	Ser	Glu
180				185				190							
Glu	Lys	Arg	Lys	Lys	Ala	Leu	Lys	Leu	Gly	Ala	Asp	Tyr	Ala	Phe	Asp
195				200				205							
Ser	Tyr	Ser	Asn	Trp	Asp	Glu	Gln	Leu	Gln	Gly	Lys	Lys	Ile	Asp	Val
210				215				220							
Val	Leu	Asp	Ser	Ile	Gly	Pro	Ala	Leu	Phe	Ser	Glu	Tyr	Phe	Arg	His
225				230				235				240			
Val	Lys	Pro	Asn	Gly	Arg	Ile	Val	Ser	Phe	Gly	Ala	Ser	Ser	Gly	Asp
245				250				255							
Asn	Leu	Ser	Phe	Pro	Val	Arg	Ser	Leu	Phe	Phe	Pro	Gln	Val	Asn	Val
260				265				270							
Leu	Gly	Thr	Ser	Met	Gly	Ser	Gly	Glu	Glu	Phe	Gln	Ala	Met	Leu	Ala
275				280				285							
Phe	Ile	Asp	Lys	His	Lys	Leu	Arg	Pro	Val	Ile	Asp	Arg	Ile	Tyr	Pro
290				295				300							
Leu	Glu	Lys	Ala	Cys	Glu	Ala	Tyr	Lys	Arg	Met	Gln	Glu	Gly	Arg	Gln
305				310				315				320			
Phe	Gly	Asn	Ile	Gly	Ile	Val	Met	Glu							

325

<210> 86

<211> 990

<212> DNA

<213> 枯草杆菌

<400> 86

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catcgtgact tgtttcttat gaaaaacaaa tctgaacaag atcctcacat gatactgggt 180
tctgacggcg cgggtatcat cgaagagatt ggtgaaggcg tgaaaaatgt tactgttcag 240
acagaagtag tcattttccc gacattgaac tgggatttga cagaaaatgt tccacctgta 300
cctgagattc tgggaggtcc ttcggacgga acattgctg aatatgtgat cattccttca 360
caaaatgcaa tcaaaaaacc tgcttattta tcttggaag aagcgggcgt tttaccttta 420
tccgctttaa ctgcatatcg ggctctgttt acaaaggggc aattaaaaaa aggcgagcat 480
ctattgatac ccggcatcgg cagcggtgta gcaacctacg ctttatttat ggctaaggcg 540
attggggcaa cagtaagcgt gacctccgc agtgaggaga aaagaaaaaa ggcgctgaaa 600
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aagatagatg ttgttcttga cagcatagga cctgccctct tttcggaata cttccgcat 720
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ccggtgcgtt ctttattctt tcctcaggtc aatgttttgg gaacctcgat gggaagcgg 840
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cggatatatc ctttagaaaa agcatgtgaa gcatataaaa gaatgcagga aggcagacag 960
tttgaaaca tcgggatcgt aatggaataa 990

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<210> 87

<211> 390

<212> PRT

<213> 枯草杆菌

<400> 87

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Met Glu Asn Phe Thr Tyr Tyr Asn Pro Thr Lys Leu Ile Phe Gly Lys
1           5           10           15
Gly Gln Leu Glu Gln Leu Arg Lys Glu Phe Lys Arg Tyr Gly Lys Asn
          20           25           30
Val Leu Leu Val Tyr Gly Gly Gly Ser Ile Lys Arg Asn Gly Leu Tyr
          35           40           45
Asp Gln Val Thr Gly Ile Leu Lys Glu Glu Gly Ala Val Val His Glu
          50           55           60
Leu Ser Gly Val Glu Pro Asn Pro Arg Leu Ala Thr Val Glu Lys Gly
65           70           75           80
Ile Gly Leu Cys Arg Glu His Asp Ile Asp Phe Leu Leu Ala Val Gly

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85					90					95						
Gly	Gly	Ser	Val	Ile	Asp	Cys	Thr	Lys	Ala	Ile	Ala	Ala	Gly	Val	Lys	
100					105					110						
Tyr	Asp	Gly	Asp	Ala	Trp	Asp	Ile	Phe	Ser	Lys	Lys	Val	Thr	Ala	Glu	
115					120					125						
Asp	Ala	Leu	Pro	Phe	Gly	Thr	Val	Leu	Thr	Leu	Ala	Ala	Thr	Gly	Ser	
130					135					140						
Glu	Met	Asn	Pro	Asp	Ser	Val	Ile	Thr	Asn	Trp	Glu	Thr	Asn	Glu	Lys	
145					150					155					160	
Phe	Val	Trp	Gly	Ser	Asn	Val	Thr	His	Pro	Arg	Phe	Ser	Ile	Leu	Asp	
165					170					175						
Pro	Glu	Asn	Thr	Phe	Thr	Val	Pro	Glu	Asn	Gln	Thr	Val	Tyr	Gly	Met	
180					185					190						
Val	Asp	Met	Met	Ser	His	Val	Phe	Glu	Gln	Tyr	Phe	His	Asn	Val	Glu	
195					200					205						
Asn	Thr	Pro	Leu	Gln	Asp	Arg	Met	Cys	Phe	Ala	Val	Leu	Gln	Thr	Val	
210					215					220						
Ile	Glu	Thr	Ala	Pro	Lys	Leu	Leu	Glu	Asp	Leu	Glu	Asn	Tyr	Glu	Leu	
225					230					235					240	
Arg	Glu	Thr	Ile	Leu	Tyr	Ala	Gly	Thr	Ile	Ala	Leu	Asn	Gly	Thr	Leu	
245					250					255						
Gln	Met	Gly	Tyr	Phe	Gly	Asp	Trp	Ala	Ser	His	Thr	Met	Glu	His	Ala	
260					265					270						
Val	Ser	Ala	Val	Tyr	Asp	Ile	Pro	His	Ala	Gly	Gly	Leu	Ala	Ile	Leu	
275					280					285						
Phe	Pro	Asn	Trp	Met	Arg	Tyr	Thr	Leu	Asp	Thr	Asn	Val	Gly	Arg	Phe	
290					295					300						
Lys	Asn	Leu	Met	Leu	Asn	Met	Phe	Asp	Ile	Asp	Thr	Glu	Gly	Lys	Thr	
305					310					315					320	
Asp	Lys	Glu	Ile	Ala	Leu	Glu	Gly	Ile	Asp	Lys	Leu	Ser	Ala	Phe	Trp	
325					330					335						
Thr	Ser	Leu	Gly	Ala	Pro	Ser	Arg	Leu	Ala	Asp	Tyr	Asn	Ile	Gly	Glu	
340					345					350						
Glu	Lys	Leu	Glu	Leu	Ile	Ala	Asp	Ile	Ala	Ala	Lys	Glu	Met	Glu	His	
355					360					365						
Gly	Gly	Phe	Gly	Asn	Phe	Gln	Lys	Leu	Asn	Lys	Asp	Asp	Val	Leu	Ala	
370					375					380						
Ile	Leu	Arg	Ala	Ser	Leu											
385					390											

<210> 88

<211> 1173

<212> DNA

<213> 枯草杆菌

<400> 88

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gttggttcatt agctgtcagg ttagagacca aaccgcgctc ttgcgacagt ggaaaaaggc 240
ataggacttt gcagagagca tgacattgat tttctgcttg ctgtcggcgg aggcagtgtg 300
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<210> 89

<211> 387

<212> PRT

<213> 枯草杆菌

<400> 89

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Met Gln Asn Phe Thr Tyr Trp Asn Pro Thr Lys Leu Ile Phe Gly Arg
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Gly Glu Val Glu Arg Leu Pro Glu Glu Leu Lys Pro Tyr Gly Lys Asn
           20           25           30
Val Leu Leu Val Tyr Gly Gly Gly Ser Ile Lys Arg Ser Gly Leu Tyr
           35           40           45
Asp Gln Val Ile Glu Gln Leu Asn Lys Ala Gly Ala Thr Val His Glu
           50           55           60
Leu Ala Gly Val Glu Pro Asn Pro Arg Val Ser Thr Val Asn Lys Gly

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65	70	75	80
Val Ala Ile Cys Lys Glu Gln Asn Ile Asp Phe Leu Leu Ala Val Gly			
	85	90	95
Gly Gly Ser Val Ile Asp Cys Thr Lys Ala Ile Ala Ala Gly Ala Lys			
	100	105	110
Tyr Asp Gly Asp Ala Trp Asp Ile Val Thr Lys Lys His Gln Pro Lys			
	115	120	125
Asp Ala Leu Pro Phe Gly Thr Val Leu Thr Leu Ala Ala Thr Gly Ser			
	130	135	140
Glu Met Asn Ser Gly Ser Val Ile Thr Asn Trp Glu Thr Lys Glu Lys			
145	150	155	160
Tyr Gly Trp Gly Ser Pro Leu Val Phe Pro Lys Phe Ser Ile Leu Asp			
	165	170	175
Pro Val Asn Thr Phe Thr Val Pro Lys Asn His Thr Ile Tyr Gly Met			
	180	185	190
Val Asp Met Met Ser His Val Phe Glu Gln Tyr Phe His His Val Ser			
	195	200	205
Asn Thr Pro Tyr Gln Asp Arg Met Cys Glu Ser Leu Leu Arg Thr Val			
	210	215	220
Ile Glu Thr Ala Pro Lys Leu Ile Asn Asp Leu Glu Asn Tyr Glu Leu			
225	230	235	240
Arg Glu Thr Ile Leu Tyr Thr Gly Thr Ile Ala Leu Asn Gly Met Leu			
	245	250	255
Ser Met Gly Ala Arg Gly Asp Trp Ala Thr His Asn Ile Glu His Ala			
	260	265	270
Val Ser Ala Val Tyr Asp Ile Pro His Ala Gly Gly Leu Ala Ile Leu			
	275	280	285
Phe Pro Asn Trp Met Arg His Thr Leu Ser Glu Asn Pro Ala Arg Met			
	290	295	300
Lys Gln Leu Ala Val Arg Val Phe Asp Val Glu Glu Ala Gly Lys Thr			
305	310	315	320
Asp Glu Glu Ile Ala Leu Glu Gly Ile Asp Lys Leu Ser Ala Phe Trp			
	325	330	335
Thr Ser Leu Gly Ala Pro Asn Arg Leu Ala Asp Tyr Asp Ile Asn Asp			
	340	345	350
Glu Gln Leu Asp Thr Ile Ala Asp Lys Ala Met Ala Asn Gly Thr Phe			
	355	360	365
Gly Gln Phe Lys Ser Leu Asn Lys Glu Asp Val Leu Ser Ile Leu Lys			
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Ala Ser Leu

385

<210> 90

<211> 1164

<212> DNA

<213> 枯草杆菌

<400> 90

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agcattaaac gcagcggcct gtatgatcaa gtgattgaac agctgaataa agccggagcg 180
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gttgccatct gtaaagaaca aaacattgat ttcttgcctg ctgtcggagg cggaagcgta 300
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tcaattttga aagcatcact ataa 1164

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<210> 91

<211> 331

<212> PRT

<213> 枯草杆菌

<400> 91

Met Glu Tyr Thr Ser Ile Ala Asp Thr Gly Ile Glu Ala Ser Arg Ile

1

5

10

15

Gly Leu Gly Thr Trp Ala Ile Gly Gly Thr Met Trp Gly Gly Thr Asp

20

25

30

Glu Lys Thr Ser Ile Glu Thr Ile Arg Ala Ala Leu Asp Gln Gly Ile

35

40

45

Thr Leu Ile Asp Thr Ala Pro Ala Tyr Gly Phe Gly Gln Ser Glu Glu

50	55	60
Ile Val Gly Lys Ala	Ile Lys Glu Tyr Gly Lys Arg Asp Gln Val Ile	
65	70	75
Leu Ala Thr Lys Thr Ala Leu Asp Trp Lys Asn Asn Gln Leu Phe Arg		80
	85	90
His Ala Asn Arg Ala Arg Ile Val Glu Glu Val Glu Asn Ser Leu Lys		95
	100	105
Arg Leu Gln Thr Asp Tyr Ile Asp Leu Tyr Gln Val His Trp Pro Asp		110
	115	120
Pro Leu Val Pro Ile Glu Glu Thr Ala Glu Val Met Lys Glu Leu Tyr		125
	130	135
Asp Ala Gly Lys Ile Arg Ala Ile Gly Val Ser Asn Phe Ser Ile Glu		140
145	150	155
Gln Met Asp Thr Phe Arg Ala Val Ala Pro Leu His Thr Ile Gln Pro		160
	165	170
Pro Tyr Asn Leu Phe Glu Arg Glu Met Glu Glu Ser Val Leu Pro Tyr		175
	180	185
Ala Lys Asp Asn Lys Ile Thr Thr Leu Leu Tyr Gly Ser Leu Cys Arg		190
	195	200
Gly Leu Leu Thr Gly Lys Met Thr Glu Glu Tyr Thr Phe Glu Gly Asp		205
	210	215
Asp Leu Arg Asn His Asp Pro Lys Phe Gln Lys Pro Arg Phe Lys Glu		220
225	230	235
Tyr Leu Ser Ala Val Asn Gln Leu Asp Lys Leu Ala Lys Thr Arg Tyr		240
	245	250
Gly Lys Ser Val Ile His Leu Ala Val Arg Trp Ile Leu Asp Gln Pro		255
	260	265
Gly Ala Asp Ile Ala Leu Trp Gly Ala Arg Lys Pro Gly Gln Leu Glu		270
	275	280
Ala Leu Ser Glu Ile Thr Gly Trp Thr Leu Asn Ser Glu Asp Gln Lys		285
	290	295
Asp Ile Asn Thr Ile Leu Glu Asn Thr Ile Ser Asp Pro Val Gly Pro		300
305	310	315
Glu Phe Met Ala Pro Pro Thr Arg Glu Glu Ile		320
	325	330

<210> 92

<211> 996

<212> DNA

<213> 枯草杆菌

<400> 92

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 cgcgccgctc ttgatcaggg gattacactg attgacaccg caccggctta cggcttcggg 180
 cagtccgagg aaattgtcgg aaaggcaatc aaagagtacg gcaaaagaga ccaggtgatt 240
 ctcgcaacga aaacggctct ggactggaag aacaaccagc tgttccgcca tgcgaacaga 300
 gcgagaattg tagaggaagt tgagaattct ttgaagcggc ttcaaacaga ctatattgat 360
 ctttatcagg tgcattggcc cgatccgctt gtgccattg aagaaacggc tgaagtcatg 420
 aaggaattat atgatgcggg aaaaatccgg gcgattggcg tcagcaatth ttcaattgag 480
 caaatggata catttcgcgc cgtcgcacct ctccatacga ttcagcctcc atataatctg 540
 tttgaaagag agatggaaga gagtgtcctt ctttatgcga aagataacaa gataacaaca 600
 ttattatacg gcagtttatg cagagggctg ttaacaggca aatgactga agaataataca 660
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 tatctttctg ctgtgaatca attggataag ctggcgaaga cacgttatgg aaaatcagtg 780
 attcacttgg ctgtcagatg gatcttagat cagccgggag cggatatcgc tctttgggga 840
 gcaagaaagc ctgggcagct tgaggcccta tctgagatta caggctggac gctgaacagt 900
 gaagatcaga aagatatcaa tactatattg gaaaatacga tatcagaccc tgtcggaccg 960
 gagtttatgg ccccgccgac cagagaggaa atataa 996

<210> 93

<211> 306

<212> PRT

<213> 枯草杆菌

<400> 93

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 Gly Leu Gly Cys Met Ser Leu Gly Thr Glu Lys Asn Lys Ala Leu Ser
 20 25 30
 Ile Leu Asp Glu Ala Ile Glu Leu Gly Ile Asn Tyr Leu Asp Thr Ala
 35 40 45
 Asp Leu Tyr Asp Arg Gly Arg Asn Glu Glu Ile Val Gly Asp Ala Ile
 50 55 60
 Gln Asn Arg Arg His Asp Ile Ile Leu Ala Thr Lys Ala Gly Asn Arg
 65 70 75 80
 Trp Asp Asp Gly Ser Glu Gly Trp Tyr Trp Asp Pro Ser Lys Ala Tyr
 85 90 95
 Ile Lys Glu Ala Val Lys Lys Ser Leu Thr Arg Leu Lys Thr Asp Tyr
 100 105 110
 Ile Asp Leu Tyr Gln Leu His Gly Gly Thr Ile Glu Asp Asn Ile Asp
 115 120 125

Glu Thr Ile Glu Ala Phe Glu Glu Leu Lys Gln Glu Gly Val Ile Arg
 130 135 140
 Tyr Tyr Gly Ile Ser Ser Ile Arg Pro Asn Val Ile Lys Glu Tyr Val
 145 150 155 160
 Lys Lys Ser Asn Ile Val Ser Ile Met Met Gln Phe Ser Leu Phe Asp
 165 170 175
 Arg Arg Pro Glu Glu Trp Leu Pro Leu Leu Glu Glu His Gln Ile Ser
 180 185 190
 Val Val Ala Arg Gly Pro Val Ala Lys Gly Leu Leu Thr Glu Lys Pro
 195 200 205
 Leu Asp Gln Ala Ser Glu Ser Met Lys Gln Asn Gly Tyr Leu Ser Tyr
 210 215 220
 Ser Phe Glu Glu Leu Thr Asn Ala Arg Lys Ala Met Glu Glu Val Ala
 225 230 235 240
 Pro Asp Leu Ser Met Thr Glu Lys Ser Leu Gln Tyr Leu Leu Ala Gln
 245 250 255
 Pro Ala Val Ala Ser Val Ile Thr Gly Ala Ser Lys Ile Glu Gln Leu
 260 265 270
 Arg Glu Asn Ile Gln Ala Ala Asn Ala Arg Arg Leu Thr Glu Glu Glu
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Arg Ser

305

<210> 94

<211> 921

<212> DNA

<213> 枯草杆菌

<400> 94

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 ggcatcaact atttggacac agcggatttg tatgaccggg gacgcaatga agaaattgtc 180
 ggtgatgcga tccaaaacag acgcatgat attattctgg caacaaaagc gggaaaccgt 240
 tgggatgacg gaagcgaggg ctggtatttg gacccttcaa aagcttacat aaaagaggcg 300
 gtaaaaaaga gccttacacg tctgaaaaca gattatatcg acctttatca gctccacggc 360
 ggacacgatag aggacaacat tgatgaaacg attgaagcgt ttgaggaatt aaaacaagaa 420
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 aaaaaatcaa acatcgtcag cattatgatg caattcagcc tgtttgacag acgccctgag 540
 gaatggctcc cgcttttaga ggaacatcaa atcagcgtag tcgccagagg tcctgttgcc 600

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 tacttgctcct attcattcga ggaactgaca aatgcccgta aggcaatgga ggaagtggct 720
 cccgatcttt ccatgacaga aaagtcgctg cagtatctgc tagcacagcc ggctgtcgtc 780
 tcagtgatta caggcgccag taagattgag cagttacggg aaaatattca ggcagcaaat 840
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<210> 95

<211> 310

<212> PRT

<213> 枯草杆菌

<400> 95

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Ile	Gly	Phe	Gly	Ala	Asn	Ala	Val	Gly	Gly	His	Asn	Leu	Phe	Pro	Asn
			20					25					30		
Leu	Asn	Asp	Glu	Thr	Gly	Lys	Asp	Leu	Val	Arg	Thr	Ala	Leu	Asp	Gly
			35				40					45			
Gly	Val	Asn	Phe	Ile	Asp	Thr	Ala	Phe	Ile	Tyr	Gly	Leu	Gly	Arg	Ser
	50					55				60					
Glu	Glu	Leu	Ile	Gly	Glu	Val	Val	Gln	Glu	Arg	Gly	Val	Arg	Asn	Glu
65				70					75					80	
Leu	Ile	Ile	Ala	Thr	Lys	Gly	Ala	His	Lys	Glu	Val	Asp	Gly	Ser	Ile
			85					90					95		
Glu	Leu	Asp	Asn	Ser	Arg	Glu	Phe	Leu	Arg	Ser	Glu	Val	Glu	Lys	Ser
		100						105					110		
Leu	Lys	Arg	Leu	Lys	Thr	Asp	Tyr	Ile	Asp	Leu	Tyr	Tyr	Val	His	Phe
		115					120					125			
Pro	Asp	Gly	Lys	Thr	Pro	Leu	Ala	Glu	Val	Ala	Gly	Thr	Leu	Lys	Glu
		130				135					140				
Leu	Lys	Asp	Glu	Gly	Lys	Ile	Lys	Ala	Ile	Gly	Ala	Ser	Asn	Leu	Asp
145				150						155				160	
Tyr	Gln	Gln	Leu	Gln	Asp	Phe	Asn	Ala	Asp	Gly	Tyr	Leu	Glu	Val	Phe
			165					170					175		
Gln	Ala	Glu	Tyr	Ser	Leu	Ile	Gln	Arg	Asp	Ala	Glu	Lys	Glu	Leu	Leu
			180					185					190		
Pro	Tyr	Cys	Glu	Lys	Gln	Gly	Ile	Ser	Phe	Ile	Pro	Tyr	Phe	Pro	Leu
		195				200						205			
Ala	Ser	Gly	Leu	Leu	Thr	Gly	Lys	Phe	Thr	Gln	Asp	Thr	Val	Phe	Asp
		210				215						220			

Met Lys Lys Ala Lys Leu Gly Lys Ser Asp Leu Gln Val Phe Pro Ile

1	5	10	15
Gly Leu Gly Thr Asn Ala Val Gly Gly His Asn Leu Tyr Pro Asn Leu			
20	25	30	
Asn Glu Glu Thr Gly Lys Glu Leu Val Arg Glu Ala Ile Arg Asn Gly			
35	40	45	
Val Thr Met Leu Asp Thr Ala Tyr Ile Tyr Gly Ile Gly Arg Ser Glu			
50	55	60	
Glu Leu Ile Gly Glu Val Leu Arg Glu Phe Asn Arg Glu Asp Val Val			
65	70	75	80
Ile Ala Thr Lys Ala Ala His Arg Lys Gln Gly Asn Asp Phe Val Phe			
85	90	95	
Asp Asn Ser Pro Asp Phe Leu Lys Lys Ser Val Asp Glu Ser Leu Lys			
100	105	110	
Arg Leu Asn Thr Asp Tyr Ile Asp Leu Phe Tyr Ile His Phe Pro Asp			
115	120	125	
Glu His Thr Pro Lys Asp Glu Ala Val Asn Ala Leu Asn Glu Met Lys			
130	135	140	
Lys Ala Gly Lys Ile Arg Ser Ile Gly Val Ser Asn Phe Ser Leu Glu			
145	150	155	160
Gln Leu Lys Glu Ala Asn Lys Asp Gly Leu Val Asp Val Leu Gln Gly			
165	170	175	
Glu Tyr Asn Leu Leu Asn Arg Glu Ala Glu Lys Thr Phe Phe Pro Tyr			
180	185	190	
Thr Lys Glu His Asn Ile Ser Phe Ile Pro Tyr Phe Pro Leu Val Ser			
195	200	205	
Gly Leu Leu Ala Gly Lys Tyr Thr Glu Asp Thr Thr Phe Pro Glu Gly			
210	215	220	
Asp Leu Arg Asn Glu Gln Glu His Phe Lys Gly Glu Arg Phe Lys Glu			
225	230	235	240
Asn Ile Arg Lys Val Asn Lys Leu Ala Pro Ile Ala Glu Lys His Asn			
245	250	255	
Val Asp Ile Pro His Ile Val Leu Ala Trp Tyr Leu Ala Arg Pro Glu			
260	265	270	
Ile Asp Ile Leu Ile Pro Gly Ala Lys Arg Ala Asp Gln Leu Ile Asp			
275	280	285	
Asn Ile Lys Thr Ala Asp Val Thr Leu Ser Gln Glu Asp Ile Ser Phe			
290	295	300	
Ile Asp Lys Leu Phe Ala			
305	310		

<210> 98

<211> 933

<212> DNA

<213> 枯草杆菌

<400> 98

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gtgcgcgagg cgatccgtaa tggcgtgaca atgttagaca ccgcttacat ttacgggatac 180
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aatatcagaa aggtcaacaa gcttgcgccg attgccgaaa aacacaacgt ggatatccct 780
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<210> 99

<211> 326

<212> PRT

<213> 枯草杆菌

<400> 99

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Met Glu Tyr Thr Tyr Leu Gly Arg Thr Gly Leu Arg Val Ser Arg Leu
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Cys Leu Gly Thr Met Asn Phe Gly Val Asp Thr Asp Glu Lys Thr Ala
           20           25           30
Phe Arg Ile Met Asp Glu Ala Leu Asp Asn Gly Ile Gln Phe Phe Asp
           35           40           45
Thr Ala Asn Ile Tyr Gly Trp Gly Lys Asn Ala Gly Leu Thr Glu Ser
           50           55           60
Ile Ile Gly Lys Trp Phe Ala Gln Gly Gly Gln Arg Arg Glu Lys Val
65           70           75           80
Val Leu Ala Thr Lys Val Tyr Glu Pro Ile Ser Asp Pro Asn Asp Gly
           85           90           95
Pro Asn Asp Met Arg Gly Leu Ser Leu Tyr Lys Ile Arg Arg His Leu

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100	105	110
Glu Gly Ser Leu Lys Arg Leu Gln Thr Asp His Ile Glu Leu Tyr Gln		
115	120	125
Met His His Ile Asp Arg Arg Thr Pro Trp Asp Glu Ile Trp Glu Ala		
130	135	140
Phe Glu Thr Gln Val Arg Ser Gly Lys Val Asp Tyr Ile Gly Ser Ser		
145	150	155
Asn Phe Ala Gly Trp His Leu Val Lys Ala Gln Ala Glu Ala Glu Lys		
165	170	175
Arg Arg Phe Met Gly Leu Val Thr Glu Gln His Lys Tyr Ser Leu Leu		
180	185	190
Glu Arg Thr Ala Glu Met Glu Val Leu Pro Ala Ala Arg Asp Leu Gly		
195	200	205
Leu Gly Val Val Ala Trp Ser Pro Leu Ala Gly Gly Leu Leu Gly Gly		
210	215	220
Lys Ala Leu Lys Ser Asn Ala Gly Thr Arg Thr Ala Lys Arg Ala Asp		
225	230	235
Leu Ile Glu Lys His Arg Leu Gln Leu Glu Lys Phe Ser Asp Leu Cys		
245	250	255
Lys Glu Leu Gly Glu Lys Glu Ala Asn Val Ala Leu Ala Trp Val Leu		
260	265	270
Ala Asn Pro Val Leu Thr Ala Pro Ile Ile Gly Pro Arg Thr Val Glu		
275	280	285
Gln Leu Arg Asp Thr Ile Lys Ala Val Glu Ile Ser Leu Asp Lys Glu		
290	295	300
Ile Leu Arg Met Leu Asn Asp Ile Phe Pro Gly Pro Gly Gly Glu Thr		
305	310	315
Pro Glu Ala Tyr Ala Trp		
325		

<210> 100

<211> 981

<212> DNA

<213> 枯草杆菌

<400> 100

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 aattttgcag gctggcattt agttaaagcg caagctgaag ctgaaaaacg gcgattcatg 540
 ggactcgtca ctgaacagca taagtatagt ttattagaac gaacagctga aatggaagtg 600
 ctgccggctg cacgggatct tggtttagga gtagtggcgt ggagtcccct tgcaggaggg 660
 cttcttggcg ggaaggcatt gaaaagcaat gccggaactc gtacagcaaa aagagcagat 720
 ttaattgaaa aacatcgttt gcaactcgag aaattttcag atttatgcaa agaactagga 780
 gaaaaagaag caaatgtggc tttggcatgg gtgctggcaa atccagtttt aactgcgccg 840
 atcatcggac cacgaacggt tgagcagctg cgtgatacga taaaagccgt tgaaatcagt 900
 ctggataagg agatttccg catgttaa atgatatcttc ccggacctgg aggagagaca 960
 cctgaggcat acgcctggtg a 981

<210> 101

<211> 1174

<212> PRT

<213> 艾阿华诺卡氏菌

<400> 101

Met	Ala	Val	Asp	Ser	Pro	Asp	Glu	Arg	Leu	Gln	Arg	Arg	Ile	Ala	Gln
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Leu	Phe	Ala	Glu	Asp	Glu	Gln	Val	Lys	Ala	Ala	Arg	Pro	Leu	Glu	Ala
			20						25					30	
Val	Ser	Ala	Ala	Val	Ser	Ala	Pro	Gly	Met	Arg	Leu	Ala	Gln	Ile	Ala
			35						40					45	
Ala	Thr	Val	Met	Ala	Gly	Tyr	Ala	Asp	Arg	Pro	Ala	Ala	Gly	Gln	Arg
			50						55					60	
Ala	Phe	Glu	Leu	Asn	Thr	Asp	Asp	Ala	Thr	Gly	Arg	Thr	Ser	Leu	Arg
65									70					75	
Leu	Leu	Pro	Arg	Phe	Glu	Thr	Ile	Thr	Tyr	Arg	Glu	Leu	Trp	Gln	Arg
									85					90	
Val	Gly	Glu	Val	Ala	Ala	Ala	Trp	His	His	Asp	Pro	Glu	Asn	Pro	Leu
									100					105	
Arg	Ala	Gly	Asp	Phe	Val	Ala	Leu	Leu	Gly	Phe	Thr	Ser	Ile	Asp	Tyr
									110					115	
Ala	Thr	Leu	Asp	Leu	Ala	Asp	Ile	His	Leu	Gly	Ala	Val	Thr	Val	Pro
									120					125	
Leu	Gln	Ala	Ser	Ala	Ala	Val	Ser	Gln	Leu	Ile	Ala	Ile	Leu	Thr	Glu
130									135					140	
Leu	Gln	Ala	Ser	Ala	Ala	Val	Ser	Gln	Leu	Ile	Ala	Ile	Leu	Thr	Glu
145									150					155	
Thr	Ser	Pro	Arg	Leu	Leu	Ala	Ser	Thr	Pro	Glu	His	Leu	Asp	Ala	Ala
									160					165	
									170					175	

Val	Glu	Cys	Leu	Leu	Ala	Gly	Thr	Thr	Pro	Glu	Arg	Leu	Val	Val	Phe		
180						185						190					
Asp	Tyr	His	Pro	Glu	Asp	Asp	Asp	Gln	Arg	Ala	Ala	Phe	Glu	Ser	Ala		
195						200						205					
Arg	Arg	Arg	Leu	Ala	Asp	Ala	Gly	Ser	Ser	Val	Ile	Val	Glu	Thr	Leu		
210						215						220					
Asp	Ala	Val	Arg	Ala	Arg	Gly	Arg	Asp	Leu	Pro	Ala	Ala	Pro	Leu	Phe		
225						230						235				240	
Val	Pro	Asp	Thr	Asp	Asp	Asp	Pro	Leu	Ala	Leu	Leu	Ile	Tyr	Thr	Ser		
245						250						255					
Gly	Ser	Thr	Gly	Thr	Pro	Lys	Gly	Ala	Met	Tyr	Thr	Asn	Arg	Leu	Ala		
260						265						270					
Ala	Thr	Met	Trp	Gln	Gly	Asn	Ser	Met	Leu	Gln	Gly	Asn	Ser	Gln	Arg		
275						280						285					
Val	Gly	Ile	Asn	Leu	Asn	Tyr	Met	Pro	Met	Ser	His	Ile	Ala	Gly	Arg		
290						295						300					
Ile	Ser	Leu	Phe	Gly	Val	Leu	Ala	Arg	Gly	Gly	Thr	Ala	Tyr	Phe	Ala		
305						310						315				320	
Ala	Lys	Ser	Asp	Met	Ser	Thr	Leu	Phe	Glu	Asp	Ile	Gly	Leu	Val	Arg		
325						330						335					
Pro	Thr	Glu	Ile	Phe	Phe	Val	Pro	Arg	Val	Cys	Asp	Met	Val	Phe	Gln		
340						345						350					
Arg	Tyr	Gln	Ser	Glu	Leu	Asp	Arg	Arg	Ser	Val	Ala	Gly	Ala	Asp	Leu		
355						360						365					
Asp	Thr	Leu	Asp	Arg	Glu	Val	Lys	Ala	Asp	Leu	Arg	Gln	Asn	Tyr	Leu		
370						375						380					
Gly	Gly	Arg	Phe	Leu	Val	Ala	Val	Val	Gly	Ser	Ala	Pro	Leu	Ala	Ala		
385						390						395				400	
Glu	Met	Lys	Thr	Phe	Met	Glu	Ser	Val	Leu	Asp	Leu	Pro	Leu	His	Asp		
405						410						415					
Gly	Tyr	Gly	Ser	Thr	Glu	Ala	Gly	Ala	Ser	Val	Leu	Leu	Asp	Asn	Gln		
420						425						430					
Ile	Gln	Arg	Pro	Pro	Val	Leu	Asp	Tyr	Lys	Leu	Val	Asp	Val	Pro	Glu		
435						440						445					
Leu	Gly	Tyr	Phe	Arg	Thr	Asp	Arg	Pro	His	Pro	Arg	Gly	Glu	Leu	Leu		
450						455						460					
Leu	Lys	Ala	Glu	Thr	Thr	Ile	Pro	Gly	Tyr	Tyr	Lys	Arg	Pro	Glu	Val		
465						470						475				480	
Thr	Ala	Glu	Ile	Phe	Asp	Glu	Asp	Gly	Phe	Tyr	Lys	Thr	Gly	Asp	Ile		

				485				490				495			
Val	Ala	Glu	Leu	Glu	His	Asp	Arg	Leu	Val	Tyr	Val	Asp	Arg	Arg	Asn
				500				505				510			
Asn	Val	Leu	Lys	Leu	Ser	Gln	Gly	Glu	Phe	Val	Thr	Val	Ala	His	Leu
				515				520				525			
Glu	Ala	Val	Phe	Ala	Ser	Ser	Pro	Leu	Ile	Arg	Gln	Ile	Phe	Ile	Tyr
				530				535				540			
Gly	Ser	Ser	Glu	Arg	Ser	Tyr	Leu	Leu	Ala	Val	Ile	Val	Pro	Thr	Asp
545				550				555				560			
Asp	Ala	Leu	Arg	Gly	Arg	Asp	Thr	Ala	Thr	Leu	Lys	Ser	Ala	Leu	Ala
				565				570				575			
Glu	Ser	Ile	Gln	Arg	Ile	Ala	Lys	Asp	Ala	Asn	Leu	Gln	Pro	Tyr	Glu
				580				585				590			
Ile	Pro	Arg	Asp	Phe	Leu	Ile	Glu	Thr	Glu	Pro	Phe	Thr	Ile	Ala	Asn
				595				600				605			
Gly	Leu	Leu	Ser	Gly	Ile	Ala	Lys	Leu	Leu	Arg	Pro	Asn	Leu	Lys	Glu
610				615				620							
Arg	Tyr	Gly	Ala	Gln	Leu	Glu	Gln	Met	Tyr	Thr	Asp	Leu	Ala	Thr	Gly
625				630				635				640			
Gln	Ala	Asp	Glu	Leu	Leu	Ala	Leu	Arg	Arg	Glu	Ala	Ala	Asp	Leu	Pro
				645				650				655			
Val	Leu	Glu	Thr	Val	Ser	Arg	Ala	Ala	Lys	Ala	Met	Leu	Gly	Val	Ala
				660				665				670			
Ser	Ala	Asp	Met	Arg	Pro	Asp	Ala	His	Phe	Thr	Asp	Leu	Gly	Gly	Asp
				675				680				685			
Ser	Leu	Ser	Ala	Leu	Ser	Phe	Ser	Asn	Leu	Leu	His	Glu	Ile	Phe	Gly
690				695				700							
Val	Glu	Val	Pro	Val	Gly	Val	Val	Val	Ser	Pro	Ala	Asn	Glu	Leu	Arg
705				710				715				720			
Asp	Leu	Ala	Asn	Tyr	Ile	Glu	Ala	Glu	Arg	Asn	Ser	Gly	Ala	Lys	Arg
				725				730				735			
Pro	Thr	Phe	Thr	Ser	Val	His	Gly	Gly	Gly	Ser	Glu	Ile	Arg	Ala	Ala
				740				745				750			
Asp	Leu	Thr	Leu	Asp	Lys	Phe	Ile	Asp	Ala	Arg	Thr	Leu	Ala	Ala	Ala
				755				760				765			
Asp	Ser	Ile	Pro	His	Ala	Pro	Val	Pro	Ala	Gln	Thr	Val	Leu	Leu	Thr
770				775				780							
Gly	Ala	Asn	Gly	Tyr	Leu	Gly	Arg	Phe	Leu	Cys	Leu	Glu	Trp	Leu	Glu
785				790				795				800			

Arg Leu Asp Lys Thr Gly Gly Thr Leu Ile Cys Val Val Arg Gly Ser		
805	810	815
Asp Ala Ala Ala Ala Arg Lys Arg Leu Asp Ser Ala Phe Asp Ser Gly		
820	825	830
Asp Pro Gly Leu Leu Glu His Tyr Gln Gln Leu Ala Ala Arg Thr Leu		
835	840	845
Glu Val Leu Ala Gly Asp Ile Gly Asp Pro Asn Leu Gly Leu Asp Asp		
850	855	860
Ala Thr Trp Gln Arg Leu Ala Glu Thr Val Asp Leu Ile Val His Pro		
865	870	875
Ala Ala Leu Val Asn His Val Leu Pro Tyr Thr Gln Leu Phe Gly Pro		
885	890	895
Asn Val Val Gly Thr Ala Glu Ile Val Arg Leu Ala Ile Thr Ala Arg		
900	905	910
Arg Lys Pro Val Thr Tyr Leu Ser Thr Val Gly Val Ala Asp Gln Val		
915	920	925
Asp Pro Ala Glu Tyr Gln Glu Asp Ser Asp Val Arg Glu Met Ser Ala		
930	935	940
Val Arg Val Val Arg Glu Ser Tyr Ala Asn Gly Tyr Gly Asn Ser Lys		
945	950	955
Trp Ala Gly Glu Val Leu Leu Arg Glu Ala His Asp Leu Cys Gly Leu		
965	970	975
Pro Val Ala Val Phe Arg Ser Asp Met Ile Leu Ala His Ser Arg Tyr		
980	985	990
Ala Gly Gln Leu Asn Val Gln Asp Val Phe Thr Arg Leu Ile Leu Ser		
995	1000	1005
Leu Val Ala Thr Gly Ile Ala Pro Tyr Ser Phe Tyr Arg Thr Asp		
1010	1015	1020
Ala Asp Gly Asn Arg Gln Arg Ala His Tyr Asp Gly Leu Pro Ala		
1025	1030	1035
Asp Phe Thr Ala Ala Ala Ile Thr Ala Leu Gly Ile Gln Ala Thr		
1040	1045	1050
Glu Gly Phe Arg Thr Tyr Asp Val Leu Asn Pro Tyr Asp Asp Gly		
1055	1060	1065
Ile Ser Leu Asp Glu Phe Val Asp Trp Leu Val Glu Ser Gly His		
1070	1075	1080
Pro Ile Gln Arg Ile Thr Asp Tyr Ser Asp Trp Phe His Arg Phe		
1085	1090	1095
Glu Thr Ala Ile Arg Ala Leu Pro Glu Lys Gln Arg Gln Ala Ser		

1100	1105	1110
Val Leu Pro Leu Leu Asp	Ala Tyr Arg Asn Pro	Cys Pro Ala Val
1115	1120	1125
Arg Gly Ala Ile Leu Pro	Ala Lys Glu Phe Gln	Ala Ala Val Gln
1130	1135	1140
Thr Ala Lys Ile Gly Pro	Glu Gln Asp Ile Pro	His Leu Ser Ala
1145	1150	1155
Pro Leu Ile Asp Lys Tyr	Val Ser Asp Leu Glu	Leu Leu Gln Leu
1160	1165	1170
Leu		
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<212> PRT		
<213> 海洋分枝杆菌		
<400> 102		
Met Ser Pro Ile Thr Arg	Glu Glu Arg Leu Glu	Arg Arg Ile Gln Asp
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Leu Tyr Ala Asn Asp Pro	Gln Phe Ala Ala Ala	Lys Pro Ala Thr Ala
20	25	30
Ile Thr Ala Ala Ile Glu	Arg Pro Gly Leu Pro	Leu Pro Gln Ile Ile
35	40	45
Glu Thr Val Met Thr Gly	Tyr Ala Asp Arg Pro	Ala Leu Ala Gln Arg
50	55	60
Ser Val Glu Phe Val Thr	Asp Ala Gly Thr Gly	His Thr Thr Leu Arg
65	70	75
Leu Leu Pro His Phe Glu	Thr Ile Ser Tyr Gly	Glu Leu Trp Asp Arg
85	90	95
Ile Ser Ala Leu Ala Asp	Val Leu Ser Thr Glu	Gln Thr Val Lys Pro
100	105	110
Gly Asp Arg Val Cys Leu	Leu Gly Phe Asn Ser	Val Asp Tyr Ala Thr
115	120	125
Ile Asp Met Thr Leu Ala	Arg Leu Gly Ala Val	Ala Val Pro Leu Gln
130	135	140
Thr Ser Ala Ala Ile Thr	Gln Leu Gln Pro Ile	Val Ala Glu Thr Gln
145	150	155
Pro Thr Met Ile Ala Ala	Ser Val Asp Ala Leu	Ala Asp Ala Thr Glu
165	170	175
Leu Ala Leu Ser Gly Gln	Thr Ala Thr Arg Val	Leu Val Phe Asp His
180	185	190

His Arg Gln Val Asp Ala His Arg Ala Ala Val Glu Ser Ala Arg Glu		
195	200	205
Arg Leu Ala Gly Ser Ala Val Val Glu Thr Leu Ala Glu Ala Ile Ala		
210	215	220
Arg Gly Asp Val Pro Arg Gly Ala Ser Ala Gly Ser Ala Pro Gly Thr		
225	230	235 240
Asp Val Ser Asp Asp Ser Leu Ala Leu Leu Ile Tyr Thr Ser Gly Ser		
	245	250 255
Thr Gly Ala Pro Lys Gly Ala Met Tyr Pro Arg Arg Asn Val Ala Thr		
	260	265 270
Phe Trp Arg Lys Arg Thr Trp Phe Glu Gly Gly Tyr Glu Pro Ser Ile		
	275	280 285
Thr Leu Asn Phe Met Pro Met Ser His Val Met Gly Arg Gln Ile Leu		
	290	295 300
Tyr Gly Thr Leu Cys Asn Gly Gly Thr Ala Tyr Phe Val Ala Lys Ser		
305	310	315 320
Asp Leu Ser Thr Leu Phe Glu Asp Leu Ala Leu Val Arg Pro Thr Glu		
	325	330 335
Leu Thr Phe Val Pro Arg Val Trp Asp Met Val Phe Asp Glu Phe Gln		
	340	345 350
Ser Glu Val Asp Arg Arg Leu Val Asp Gly Ala Asp Arg Val Ala Leu		
	355	360 365
Glu Ala Gln Val Lys Ala Glu Ile Arg Asn Asp Val Leu Gly Gly Arg		
	370	375 380
Tyr Thr Ser Ala Leu Thr Gly Ser Ala Pro Ile Ser Asp Glu Met Lys		
385	390	395 400
Ala Trp Val Glu Glu Leu Leu Asp Met His Leu Val Glu Gly Tyr Gly		
	405	410 415
Ser Thr Glu Ala Gly Met Ile Leu Ile Asp Gly Ala Ile Arg Arg Pro		
	420	425 430
Ala Val Leu Asp Tyr Lys Leu Val Asp Val Pro Asp Leu Gly Tyr Phe		
	435	440 445
Leu Thr Asp Arg Pro His Pro Arg Gly Glu Leu Leu Val Lys Thr Asp		
	450	455 460
Ser Leu Phe Pro Gly Tyr Tyr Gln Arg Ala Glu Val Thr Ala Asp Val		
465	470	475 480
Phe Asp Ala Asp Gly Phe Tyr Arg Thr Gly Asp Ile Met Ala Glu Val		
	485	490 495
Gly Pro Glu Gln Phe Val Tyr Leu Asp Arg Arg Asn Asn Val Leu Lys		

500	505	510
Leu Ser Gln Gly Glu Phe Val Thr	Val Ser Lys Leu Glu Ala Val Phe	
515	520	525
Gly Asp Ser Pro Leu Val Arg Gln Ile Tyr Ile Tyr Gly Asn Ser Ala		
530	535	540
Arg Ala Tyr Leu Leu Ala Val Ile Val Pro Thr Gln Glu Ala Leu Asp		
545	550	555
Ala Val Pro Val Glu Glu Leu Lys Ala Arg Leu Gly Asp Ser Leu Gln		
565	570	575
Glu Val Ala Lys Ala Ala Gly Leu Gln Ser Tyr Glu Ile Pro Arg Asp		
580	585	590
Phe Ile Ile Glu Thr Thr Pro Trp Thr Leu Glu Asn Gly Leu Leu Thr		
595	600	605
Gly Ile Arg Lys Leu Ala Arg Pro Gln Leu Lys Lys His Tyr Gly Glu		
610	615	620
Leu Leu Glu Gln Ile Tyr Thr Asp Leu Ala His Gly Gln Ala Asp Glu		
625	630	635
Leu Arg Ser Leu Arg Gln Ser Gly Ala Asp Ala Pro Val Leu Val Thr		
645	650	655
Val Cys Arg Ala Ala Ala Ala Leu Leu Gly Gly Ser Ala Ser Asp Val		
660	665	670
Gln Pro Asp Ala His Phe Thr Asp Leu Gly Gly Asp Ser Leu Ser Ala		
675	680	685
Leu Ser Phe Thr Asn Leu Leu His Glu Ile Phe Asp Ile Glu Val Pro		
690	695	700
Val Gly Val Ile Val Ser Pro Ala Asn Asp Leu Gln Ala Leu Ala Asp		
705	710	715
Tyr Val Glu Ala Ala Arg Lys Pro Gly Ser Ser Arg Pro Thr Phe Ala		
725	730	735
Ser Val His Gly Ala Ser Asn Gly Gln Val Thr Glu Val His Ala Gly		
740	745	750
Asp Leu Ser Leu Asp Lys Phe Ile Asp Ala Ala Thr Leu Ala Glu Ala		
755	760	765
Pro Arg Leu Pro Ala Ala Asn Thr Gln Val Arg Thr Val Leu Leu Thr		
770	775	780
Gly Ala Thr Gly Phe Leu Gly Arg Tyr Leu Ala Leu Glu Trp Leu Glu		
785	790	795
Arg Met Asp Leu Val Asp Gly Lys Leu Ile Cys Leu Val Arg Ala Lys		
805	810	815

Ser Asp Thr Glu Ala Arg Ala Arg Leu Asp Lys Thr Phe Asp Ser Gly		
820	825	830
Asp Pro Glu Leu Leu Ala His Tyr Arg Ala Leu Ala Gly Asp His Leu		
835	840	845
Glu Val Leu Ala Gly Asp Lys Gly Glu Ala Asp Leu Gly Leu Asp Arg		
850	855	860
Gln Thr Trp Gln Arg Leu Ala Asp Thr Val Asp Leu Ile Val Asp Pro		
865	870	875
Ala Ala Leu Val Asn His Val Leu Pro Tyr Ser Gln Leu Phe Gly Pro		
	885	890
Asn Ala Leu Gly Thr Ala Glu Leu Leu Arg Leu Ala Leu Thr Ser Lys		
	900	905
Ile Lys Pro Tyr Ser Tyr Thr Ser Thr Ile Gly Val Ala Asp Gln Ile		
	915	920
Pro Pro Ser Ala Phe Thr Glu Asp Ala Asp Ile Arg Val Ile Ser Ala		
	930	935
Thr Arg Ala Val Asp Asp Ser Tyr Ala Asn Gly Tyr Ser Asn Ser Lys		
945	950	955
Trp Ala Gly Glu Val Leu Leu Arg Glu Ala His Asp Leu Cys Gly Leu		
	965	970
Pro Val Ala Val Phe Arg Cys Asp Met Ile Leu Ala Asp Thr Thr Trp		
	980	985
Ala Gly Gln Leu Asn Val Pro Asp Met Phe Thr Arg Met Ile Leu Ser		
	995	1000
Leu Ala Ala Thr Gly Ile Ala Pro Gly Ser Phe Tyr Glu Leu Ala		
	1010	1015
Ala Asp Gly Ala Arg Gln Arg Ala His Tyr Asp Gly Leu Pro Val		
	1025	1030
Glu Phe Ile Ala Glu Ala Ile Ser Thr Leu Gly Ala Gln Ser Gln		
	1040	1045
Asp Gly Phe His Thr Tyr His Val Met Asn Pro Tyr Asp Asp Gly		
	1055	1060
Ile Gly Leu Asp Glu Phe Val Asp Trp Leu Asn Glu Ser Gly Cys		
	1070	1075
Pro Ile Gln Arg Ile Ala Asp Tyr Gly Asp Trp Leu Gln Arg Phe		
	1085	1090
Glu Thr Ala Leu Arg Ala Leu Pro Asp Arg Gln Arg His Ser Ser		
	1100	1105
Leu Leu Pro Leu Leu His Asn Tyr Arg Gln Pro Glu Arg Pro Val		

1115	1120	1125
Arg Gly Ser Ile Ala Pro	Thr Asp Arg Phe Arg	Ala Ala Val Gln
1130	1135	1140
Glu Ala Lys Ile Gly Pro	Asp Lys Asp Ile Pro	His Val Gly Ala
1145	1150	1155
Pro Ile Ile Val Lys Tyr	Val Ser Asp Leu Arg	Leu Leu Gly Leu
1160	1165	1170
Leu		
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<212> PRT		
<213> 脓肿分枝杆菌		
<400> 103		
Met Thr Glu Thr Ile Ser Thr	Ala Ala Val Pro Thr Thr	Asp Leu Glu
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Glu Gln Val Lys Arg Arg Ile	Glu Gln Val Val Ser Asn	Asp Pro Gln
20	25	30
Leu Ala Ala Leu Leu Pro Glu	Asp Ser Val Thr Glu Ala	Val Asn Glu
35	40	45
Pro Asp Leu Pro Leu Val Glu	Val Ile Arg Arg Leu Leu	Glu Gly Tyr
50	55	60
Gly Asp Arg Pro Ala Leu Gly	Gln Arg Ala Phe Glu Phe	Val Thr Gly
65	70	75
Asp Asp Gly Ala Thr Val Ile	Ala Leu Lys Pro Glu Tyr	Thr Thr Val
85	90	95
Ser Tyr Arg Glu Leu Trp Glu	Arg Ala Glu Ala Ile Ala	Ala Ala Trp
100	105	110
His Glu Gln Gly Ile Arg Asp	Gly Asp Phe Val Ala Gln	Leu Gly Phe
115	120	125
Thr Ser Thr Asp Phe Ala Ser	Leu Asp Val Ala Gly Leu	Arg Leu Gly
130	135	140
Thr Val Ser Val Pro Leu Gln	Thr Gly Ala Ser Leu Gln	Gln Arg Asn
145	150	155
Ala Ile Leu Glu Glu Thr Arg	Pro Ala Val Phe Ala Ala	Ser Ile Glu
165	170	175
Tyr Leu Asp Ala Ala Val Asp	Ser Val Leu Ala Thr Pro	Ser Val Arg
180	185	190
Leu Leu Ser Val Phe Asp Tyr	His Ala Glu Val Asp Ser	Gln Arg Glu
195	200	205

Ala Leu Glu Ala Val Arg	Ala Arg Leu Glu Ser	Ala Gly Arg Thr Ile
210	215	220
Val Val Glu Ala Leu Ala Glu	Ala Leu Ala Arg Gly	Arg Asp Leu Pro
225	230	235 240
Ala Ala Pro Leu Pro Ser	Ala Asp Pro Asp Ala	Leu Arg Leu Leu Ile
245	250	255
Tyr Thr Ser Gly Ser Thr	Gly Thr Pro Lys Gly	Ala Met Tyr Pro Gln
260	265	270
Trp Leu Val Ala Asn Leu	Trp Gln Lys Lys Trp	Leu Thr Asp Asp Val
275	280	285
Ile Pro Ser Ile Gly Val	Asn Phe Met Pro Met	Ser His Leu Ala Gly
290	295	300
Arg Leu Thr Leu Met Gly	Thr Leu Ser Gly Gly	Gly Thr Ala Tyr Tyr
305	310	315 320
Ile Ala Ser Ser Asp Leu	Ser Thr Phe Phe Glu	Asp Ile Ala Leu Ile
325	330	335
Arg Pro Ser Glu Val Leu	Phe Val Pro Arg Val	Val Glu Met Val Phe
340	345	350
Gln Arg Phe Gln Ala Glu	Leu Asp Arg Ser Leu	Ala Pro Gly Glu Ser
355	360	365
Asn Ser Glu Ile Ala Glu	Arg Ile Lys Val Arg	Ile Arg Glu Gln Asp
370	375	380
Phe Gly Gly Arg Val Leu	Ser Ala Gly Ser Gly	Ser Ala Pro Leu Ser
385	390	395 400
Pro Glu Met Thr Glu Phe	Met Glu Ser Leu Leu	Gln Val Pro Leu Arg
405	410	415
Asp Gly Tyr Gly Ser Thr	Glu Ala Gly Gly Val	Trp Arg Asp Gly Val
420	425	430
Leu Gln Arg Pro Pro Val	Thr Asp Tyr Lys Leu	Val Asp Val Pro Glu
435	440	445
Leu Gly Tyr Phe Thr Thr	Asp Ser Pro His Pro	Arg Gly Glu Leu Arg
450	455	460
Leu Lys Ser Glu Thr Met	Phe Pro Gly Tyr Tyr	Lys Arg Pro Glu Thr
465	470	475 480
Thr Ala Asp Val Phe Asp	Asp Glu Gly Tyr Tyr	Lys Thr Gly Asp Val
485	490	495
Val Ala Glu Leu Gly Pro	Asp His Leu Lys Tyr	Leu Asp Arg Val Lys
500	505	510
Asn Val Leu Lys Leu Ala	Gln Gly Glu Phe Val	Ala Val Ser Lys Leu

515	520	525
Glu Ala Ala Tyr Thr Gly Ser Pro Leu Val Arg Gln Ile Phe Val Tyr		
530	535	540
Gly Asn Ser Glu Arg Ser Phe Leu Leu Ala Val Val Val Pro Thr Pro		
545	550	555
Glu Val Leu Glu Arg Tyr Ala Asp Ser Pro Asp Ala Leu Lys Pro Leu		
565	570	575
Ile Gln Asp Ser Leu Gln Gln Val Ala Lys Asp Ala Glu Leu Gln Ser		
580	585	590
Tyr Glu Ile Pro Arg Asp Phe Ile Val Glu Thr Val Pro Phe Thr Val		
595	600	605
Glu Ser Gly Leu Leu Ser Asp Ala Arg Lys Leu Leu Arg Pro Lys Leu		
610	615	620
Lys Asp His Tyr Gly Glu Arg Leu Glu Ala Leu Tyr Ala Glu Leu Ala		
625	630	635
Glu Ser Gln Asn Glu Arg Leu Arg Gln Leu Ala Arg Glu Ala Ala Thr		
645	650	655
Arg Pro Val Leu Glu Thr Val Thr Asp Ala Ala Ala Ala Leu Leu Gly		
660	665	670
Ala Ser Ser Ser Asp Leu Ala Pro Asp Val Arg Phe Ile Asp Leu Gly		
675	680	685
Gly Asp Ser Leu Ser Ala Leu Ser Tyr Ser Glu Leu Leu Arg Asp Ile		
690	695	700
Phe Glu Val Asp Val Pro Val Gly Val Ile Asn Ser Val Ala Asn Asp		
705	710	715
Leu Ala Ala Ile Ala Arg His Ile Glu Ala Gln Arg Thr Gly Ala Ala		
725	730	735
Thr Gln Pro Thr Phe Ala Ser Val His Gly Lys Asp Ala Thr Val Ile		
740	745	750
Thr Ala Gly Glu Leu Thr Leu Asp Lys Phe Leu Asp Glu Ser Leu Leu		
755	760	765
Lys Ala Ala Lys Asp Val Gln Pro Ala Thr Ala Asp Val Lys Thr Val		
770	775	780
Leu Val Thr Gly Gly Asn Gly Trp Leu Gly Arg Trp Leu Val Leu Asp		
785	790	795
Trp Leu Glu Arg Leu Ala Pro Asn Gly Gly Lys Val Tyr Ala Leu Ile		
805	810	815
Arg Gly Ala Asp Ala Glu Ala Ala Arg Ala Arg Leu Asp Ala Val Tyr		
820	825	830

Glu Ser Gly Asp Pro Lys Leu Ser Ala His Tyr Arg Gln Leu Ala Gln		
835	840	845
Gln Ser Leu Glu Val Ile Ala Gly Asp Phe Gly Asp Gln Asp Leu Gly		
850	855	860
Leu Ser Gln Glu Val Trp Gln Lys Leu Ala Lys Asp Val Asp Leu Ile		
865	870	875
Val His Ser Gly Ala Leu Val Asn His Val Leu Pro Tyr Ser Gln Leu		
	885	890
		895
Phe Gly Pro Asn Val Ala Gly Thr Ala Glu Ile Ile Lys Leu Ala Ile		
	900	905
		910
Ser Glu Arg Leu Lys Pro Val Thr Tyr Leu Ser Thr Val Gly Ile Ala		
	915	920
		925
Asp Gln Ile Pro Val Thr Glu Phe Glu Glu Asp Ser Asp Val Arg Val		
930	935	940
Met Ser Ala Glu Arg Gln Ile Asn Asp Gly Tyr Ala Asn Gly Tyr Gly		
945	950	955
		960
Asn Ser Lys Trp Ala Gly Glu Val Leu Leu Arg Glu Ala His Asp Leu		
	965	970
		975
Ala Gly Leu Pro Val Arg Val Phe Arg Ser Asp Met Ile Leu Ala His		
	980	985
		990
Ser Asp Tyr His Gly Gln Leu Asn Val Thr Asp Val Phe Thr Arg Ser		
	995	1000
		1005
Ile Gln Ser Leu Leu Leu Thr Gly Val Ala Pro Ala Ser Phe Tyr		
1010	1015	1020
Glu Leu Asp Ala Asp Gly Asn Arg Gln Arg Ala His Tyr Asp Gly		
1025	1030	1035
Val Pro Gly Asp Phe Thr Ala Ala Ser Ile Thr Ala Ile Gly Gly		
1040	1045	1050
Val Asn Val Val Asp Gly Tyr Arg Ser Phe Asp Val Phe Asn Pro		
1055	1060	1065
His His Asp Gly Val Ser Met Asp Thr Phe Val Asp Trp Leu Ile		
1070	1075	1080
Asp Ala Gly Tyr Lys Ile Ala Arg Ile Asp Asp Tyr Asp Gln Trp		
1085	1090	1095
Leu Ala Arg Phe Glu Leu Ala Leu Lys Gly Leu Pro Glu Gln Gln		
1100	1105	1110
Arg Gln Gln Ser Val Leu Pro Leu Leu Lys Met Tyr Glu Lys Pro		
1115	1120	1125
Gln Pro Ala Ile Asp Gly Ser Ala Leu Pro Thr Ala Glu Phe Ser		

1130	1135	1140
Arg Ala Val His Glu Ala	Lys Val Gly Asp Ser	Gly Glu Ile Pro
1145	1150	1155
His Val Thr Lys Glu Leu	Ile Leu Lys Tyr Ala	Ser Asp Ile Gln
1160	1165	1170
Leu Leu Gly Leu Val		
1175		
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Met His Gln Leu Thr Val Thr Gly Met Asn Ile Cys Glu Val Gln Arg		
1	5	10
Leu Phe Pro Arg Met Thr Ser Asp Val His Asp Ala Thr Asp Gly Val		
20	25	30
Thr Glu Thr Ala Leu Asp Asp Glu Gln Ser Thr Arg Arg Ile Ala Glu		
35	40	45
Leu Tyr Ala Thr Asp Pro Glu Phe Ala Ala Ala Pro Leu Pro Ala		
50	55	60
Val Val Asp Ala Ala His Lys Pro Gly Leu Arg Leu Ala Glu Ile Leu		
65	70	75
Gln Thr Leu Phe Thr Gly Tyr Gly Asp Arg Pro Ala Leu Gly Tyr Arg		
85	90	95
Ala Arg Glu Leu Ala Thr Asp Glu Gly Gly Arg Thr Val Thr Arg Leu		
100	105	110
Leu Pro Arg Phe Asp Thr Leu Thr Tyr Ala Gln Val Trp Ser Arg Val		
115	120	125
Gln Ala Val Ala Ala Ala Leu Arg His Asn Phe Ala Gln Pro Ile Tyr		
130	135	140
Pro Gly Asp Ala Val Ala Thr Ile Gly Phe Ala Ser Pro Asp Tyr Leu		
145	150	155
Thr Leu Asp Leu Val Cys Ala Tyr Leu Gly Leu Val Ser Val Pro Leu		
165	170	175
Gln His Asn Ala Pro Val Ser Arg Leu Ala Pro Ile Leu Ala Glu Val		
180	185	190
Glu Pro Arg Ile Leu Thr Val Ser Ala Glu Tyr Leu Asp Leu Ala Val		
195	200	205
Glu Ser Val Arg Asp Val Asn Ser Val Ser Gln Leu Val Val Phe Asp		

210	215	220
His His Pro Glu Val Asp Asp His Arg Asp Ala Leu Ala Arg Ala Arg		
225	230	235
Glu Gln Leu Ala Gly Lys Gly Ile Ala Val Thr Thr Leu Asp Ala Ile		240
	245	250
Ala Asp Glu Gly Ala Gly Leu Pro Ala Glu Pro Ile Tyr Thr Ala Asp		255
	260	265
His Asp Gln Arg Leu Ala Met Ile Leu Tyr Thr Ser Gly Ser Thr Gly		270
	275	280
Ala Pro Lys Gly Ala Met Tyr Thr Glu Ala Met Val Ala Arg Leu Trp		285
290	295	300
Thr Met Ser Phe Ile Thr Gly Asp Pro Thr Pro Val Ile Asn Val Asn		
305	310	315
Phe Met Pro Leu Asn His Leu Gly Gly Arg Ile Pro Ile Ser Thr Ala		320
	325	330
Val Gln Asn Gly Gly Thr Ser Tyr Phe Val Pro Glu Ser Asp Met Ser		335
	340	345
Thr Leu Phe Glu Asp Leu Ala Leu Val Arg Pro Thr Glu Leu Gly Leu		350
355	360	365
Val Pro Arg Val Ala Asp Met Leu Tyr Gln His His Leu Ala Thr Val		
370	375	380
Asp Arg Leu Val Thr Gln Gly Ala Asp Glu Leu Thr Ala Glu Lys Gln		
385	390	395
Ala Gly Ala Glu Leu Arg Glu Gln Val Leu Gly Gly Arg Val Ile Thr		400
	405	410
Gly Phe Val Ser Thr Ala Pro Leu Ala Ala Glu Met Arg Ala Phe Leu		415
	420	425
Asp Ile Thr Leu Gly Ala His Ile Val Asp Gly Tyr Gly Leu Thr Glu		430
	435	440
Thr Gly Ala Val Thr Arg Asp Gly Val Ile Val Arg Pro Pro Val Ile		445
450	455	460
Asp Tyr Lys Leu Ile Asp Val Pro Glu Leu Gly Tyr Phe Ser Thr Asp		
465	470	475
Lys Pro Tyr Pro Arg Gly Glu Leu Leu Val Arg Ser Gln Thr Leu Thr		480
	485	490
Pro Gly Tyr Tyr Lys Arg Pro Glu Val Thr Ala Ser Val Phe Asp Arg		495
	500	505
Asp Gly Tyr Tyr His Thr Gly Asp Val Met Ala Glu Thr Ala Pro Asp		510
515	520	525

His	Leu	Val	Tyr	Val	Asp	Arg	Arg	Asn	Asn	Val	Leu	Lys	Leu	Ala	Gln
530								535						540	
Gly	Glu	Phe	Val	Ala	Val	Ala	Asn	Leu	Glu	Ala	Val	Phe	Ser	Gly	Ala
545								550						555	560
Ala	Leu	Val	Arg	Gln	Ile	Phe	Val	Tyr	Gly	Asn	Ser	Glu	Arg	Ser	Phe
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Leu	Leu	Ala	Val	Val	Val	Pro	Thr	Pro	Glu	Ala	Leu	Glu	Gln	Tyr	Asp
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Pro	Ala	Ala	Leu	Lys	Ala	Ala	Leu	Ala	Asp	Ser	Leu	Gln	Arg	Thr	Ala
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Arg	Asp	Ala	Glu	Leu	Gln	Ser	Tyr	Glu	Val	Pro	Ala	Asp	Phe	Ile	Val
610								615						620	
Glu	Thr	Glu	Pro	Phe	Ser	Ala	Ala	Asn	Gly	Leu	Leu	Ser	Gly	Val	Gly
625								630						635	640
Lys	Leu	Leu	Arg	Pro	Asn	Leu	Lys	Asp	Arg	Tyr	Gly	Gln	Arg	Leu	Glu
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Gln	Met	Tyr	Ala	Asp	Ile	Ala	Ala	Thr	Gln	Ala	Asn	Gln	Leu	Arg	Glu
								660						665	670
Leu	Arg	Arg	Ala	Ala	Ala	Thr	Gln	Pro	Val	Ile	Asp	Thr	Leu	Thr	Gln
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Ala	Ala	Ala	Thr	Ile	Leu	Gly	Thr	Gly	Ser	Glu	Val	Ala	Ser	Asp	Ala
690								695						700	
His	Phe	Thr	Asp	Leu	Gly	Gly	Asp	Ser	Leu	Ser	Ala	Leu	Thr	Leu	Ser
705								710						715	720
Asn	Leu	Leu	Ser	Asp	Phe	Phe	Gly	Phe	Glu	Val	Pro	Val	Gly	Thr	Ile
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Val	Asn	Pro	Ala	Thr	Asn	Leu	Ala	Gln	Leu	Ala	Gln	His	Ile	Glu	Ala
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Gln	Arg	Thr	Ala	Gly	Asp	Arg	Arg	Pro	Ser	Phe	Thr	Thr	Val	His	Gly
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Ala	Asp	Ala	Thr	Glu	Ile	Arg	Ala	Ser	Glu	Leu	Thr	Leu	Asp	Lys	Phe
770								775						780	
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785								790						795	800
Thr	Glu	Pro	Arg	Thr	Val	Leu	Leu	Ser	Gly	Ala	Asn	Gly	Trp	Leu	Gly
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Arg	Phe	Leu	Thr	Leu	Gln	Trp	Leu	Glu	Arg	Leu	Ala	Pro	Val	Gly	Gly
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Thr	Leu	Ile	Thr	Ile	Val	Arg	Gly	Arg	Asp	Asp	Ala	Ala	Ala	Arg	Ala

835	840	845
Arg Leu Thr Gln Ala Tyr Asp Thr Asp Pro Glu Leu Ser Arg Arg Phe		
850	855	860
Ala Glu Leu Ala Asp Arg His Leu Arg Val Val Ala Gly Asp Ile Gly		
865	870	875
Asp Pro Asn Leu Gly Leu Thr Pro Glu Ile Trp His Arg Leu Ala Ala		880
885	890	895
Glu Val Asp Leu Val Val His Pro Ala Ala Leu Val Asn His Val Leu		
900	905	910
Pro Tyr Arg Gln Leu Phe Gly Pro Asn Val Val Gly Thr Ala Glu Val		
915	920	925
Ile Lys Leu Ala Leu Thr Glu Arg Ile Lys Pro Val Thr Tyr Leu Ser		
930	935	940
Thr Val Ser Val Ala Met Gly Ile Pro Asp Phe Glu Glu Asp Gly Asp		
945	950	955
Ile Arg Thr Val Ser Pro Val Arg Pro Leu Asp Gly Gly Tyr Ala Asn		
965	970	975
Gly Tyr Gly Asn Ser Lys Trp Ala Gly Glu Val Leu Leu Arg Glu Ala		
980	985	990
His Asp Leu Cys Gly Leu Pro Val Ala Thr Phe Arg Ser Asp Met Ile		
995	1000	1005
Leu Ala His Pro Arg Tyr Arg Gly Gln Val Asn Val Pro Asp Met		
1010	1015	1020
Phe Thr Arg Leu Leu Leu Ser Leu Leu Ile Thr Gly Val Ala Pro		
1025	1030	1035
Arg Ser Phe Tyr Ile Gly Asp Gly Glu Arg Pro Arg Ala His Tyr		
1040	1045	1050
Pro Gly Leu Thr Val Asp Phe Val Ala Glu Ala Val Thr Thr Leu		
1055	1060	1065
Gly Ala Gln Gln Arg Glu Gly Tyr Val Ser Tyr Asp Val Met Asn		
1070	1075	1080
Pro His Asp Asp Gly Ile Ser Leu Asp Val Phe Val Asp Trp Leu		
1085	1090	1095
Ile Arg Ala Gly His Pro Ile Asp Arg Val Asp Asp Tyr Asp Asp		
1100	1105	1110
Trp Val Arg Arg Phe Glu Thr Ala Leu Thr Ala Leu Pro Glu Lys		
1115	1120	1125
Arg Arg Ala Gln Thr Val Leu Pro Leu Leu His Ala Phe Arg Ala		
1130	1135	1140

Pro Gln Ala Pro Leu Arg Gly Ala Pro Glu Pro Thr Glu Val Phe
 1145 1150 1155
 His Ala Ala Val Arg Thr Ala Lys Val Gly Pro Gly Asp Ile Pro
 1160 1165 1170
 His Leu Asp Glu Ala Leu Ile Asp Lys Tyr Ile Arg Asp Leu Arg
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<210> 105

<211> 3537

<212> DNA

<213> 脓肿分枝杆菌

<400> 105

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gacgacgggtg cgaccgtgat cgcgctgaag cccgaataca ccaccgtctc ctaccgcgag 300
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<210> 106

<211> 224

<212> PRT

<213> 枯草杆菌

<400> 106

Met Lys Ile Tyr Gly Ile Tyr Met Asp Arg Pro Leu Ser Gln Glu Glu

1	5	10	15
Asn Glu Arg Phe Met Thr Phe Ile Ser Pro Glu Lys Arg Glu Lys Cys			
20	25	30	
Arg Arg Phe Tyr His Lys Glu Asp Ala His Arg Thr Leu Leu Gly Asp			
35	40	45	
Val Leu Val Arg Ser Val Ile Ser Arg Gln Tyr Gln Leu Asp Lys Ser			
50	55	60	
Asp Ile Arg Phe Ser Thr Gln Glu Tyr Gly Lys Pro Cys Ile Pro Asp			
65	70	75	80
Leu Pro Asp Ala His Phe Asn Ile Ser His Ser Gly Arg Trp Val Ile			
85	90	95	
Gly Ala Phe Asp Ser Gln Pro Ile Gly Ile Asp Ile Glu Lys Thr Lys			
100	105	110	
Pro Ile Ser Leu Glu Ile Ala Lys Arg Phe Phe Ser Lys Thr Glu Tyr			
115	120	125	
Ser Asp Leu Leu Ala Lys Asp Lys Asp Glu Gln Thr Asp Tyr Phe Tyr			
130	135	140	
His Leu Trp Ser Met Lys Glu Ser Phe Ile Lys Gln Glu Gly Lys Gly			
145	150	155	160
Leu Ser Leu Pro Leu Asp Ser Phe Ser Val Arg Leu His Gln Asp Gly			
165	170	175	
Gln Val Ser Ile Glu Leu Pro Asp Ser His Ser Pro Cys Tyr Ile Lys			
180	185	190	
Thr Tyr Glu Val Asp Pro Gly Tyr Lys Met Ala Val Cys Ala Ala His			
195	200	205	
Pro Asp Phe Pro Glu Asp Ile Thr Met Val Ser Tyr Glu Glu Leu Leu			
210	215	220	
<210> 107			
<211> 222			
<212> PRT			
<213> 艾阿华诺卡氏菌			
<400> 107			
Met Ile Glu Thr Ile Leu Pro Ala Gly Val Glu Ser Ala Glu Leu Leu			
1	5	10	15
Glu Tyr Pro Glu Asp Leu Lys Ala His Pro Ala Glu Glu His Leu Ile			
20	25	30	
Ala Lys Ser Val Glu Lys Arg Arg Arg Asp Phe Ile Gly Ala Arg His			
35	40	45	
Cys Ala Arg Leu Ala Leu Ala Glu Leu Gly Glu Pro Pro Val Ala Ile			

50	55	60
Gly Lys Gly Glu Arg	Gly Ala Pro Ile Trp	Pro Arg Gly Val Val Gly
65	70	75
Ser Leu Thr His Cys	Asp Gly Tyr Arg Ala	Ala Ala Val Ala His Lys
85	90	95
Met Arg Phe Arg Ser	Ile Gly Ile Asp Ala	Glu Pro His Ala Thr Leu
100	105	110
Pro Glu Gly Val Leu	Asp Ser Val Ser Leu	Pro Pro Glu Arg Glu Trp
115	120	125
Leu Lys Thr Thr Asp	Ser Ala Leu His Leu	Asp Arg Leu Leu Phe Cys
130	135	140
Ala Lys Glu Ala Thr	Tyr Lys Ala Trp Trp	Pro Leu Thr Ala Arg Trp
145	150	155
Leu Gly Phe Glu Glu	Ala His Ile Thr Phe	Glu Ile Glu Asp Gly Ser
165	170	175
Ala Asp Ser Gly Asn	Gly Thr Phe His Ser	Glu Leu Leu Val Pro Gly
180	185	190
Gln Thr Asn Asp Gly	Gly Thr Pro Leu Leu	Ser Phe Asp Gly Arg Trp
195	200	205
Leu Ile Ala Asp Gly	Phe Ile Leu Thr Ala	Ile Ala Tyr Ala
210	215	220

<210> 108

<211> 272

<212> PRT

<213> 酿酒酵母

<400> 108

Met Val Lys Thr Thr	Glu Val Val Ser	Glu Val Ser Lys Val Ala Gly
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20	25	30
Leu Ala Asp Glu Phe	Thr Phe Glu Ala	Leu Met Arg Thr Leu Pro Leu
35	40	45
Ala Ser Gln Ala Arg	Ile Leu Asn Lys	Lys Ser Phe His Asp Arg Cys
50	55	60
Ser Asn Leu Cys Ser	Gln Leu Leu Gln	Leu Phe Gly Cys Ser Ile Val
65	70	75
Thr Gly Leu Asn Phe	Gln Glu Leu Lys	Phe Asp Lys Gly Ser Phe Gly
85	90	95
Lys Pro Phe Leu Asp	Asn Asn Arg Phe	Leu Pro Phe Ser Met Thr Ile

100	105	110
Gly Glu Gln Tyr Val Ala Met Phe	Leu Val Lys Cys Val Ser Thr Asp	
115	120	125
Glu Tyr Gln Asp Val Gly Ile Asp	Ile Ala Ser Pro Cys Asn Tyr Gly	
130	135	140
Gly Arg Glu Glu Leu Glu Leu Phe	Lys Glu Val Phe Ser Glu Arg Glu	
145	150	155
Phe Asn Gly Leu Leu Lys Ala Ser	Asp Pro Cys Thr Ile Phe Thr Tyr	
165	170	175
Leu Trp Ser Leu Lys Glu Ser Tyr	Thr Lys Phe Thr Gly Thr Gly Leu	
180	185	190
Asn Thr Asp Leu Ser Leu Ile Asp	Phe Gly Ala Ile Ser Phe Phe Pro	
195	200	205
Ala Glu Gly Ala Ser Met Cys Ile	Thr Leu Asp Glu Val Pro Leu Ile	
210	215	220
Phe His Ser Gln Trp Phe Asn Asn	Glu Ile Val Thr Ile Cys Met Pro	
225	230	235
Lys Ser Ile Ser Asp Lys Ile Asn	Thr Asn Arg Pro Lys Leu Tyr Asn	
245	250	255
Ile Ser Leu Ser Thr Leu Ile Asp	Tyr Phe Ile Glu Asn Asp Gly Leu	
260	265	270

<210> 109

<211> 669

<212> DNA

<213> 艾阿华诺卡氏菌

<400> 109

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cgggacttca tcggggccag gcattgtgcc cggtggcgc tggctgagct cggcgagccg 180
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aacggcacct ttacagcga gctgctggtg ccgggacaga cgaatgacgg tgggacgccg 600
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tacgcctga 669

<210> 110

<211> 468

<212> PRT

<213> 大肠杆菌

<400> 110

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Met Ile Arg Glu Pro Pro Glu His Ile Leu Asn Arg Leu Pro Ser Ser
1           5           10           15
Ala Ser Ala Leu Ala Cys Ser Ala His Ala Leu Asn Leu Ile Glu Lys
          20           25           30
Arg Thr Leu Asp His Glu Glu Met Lys Ala Leu Asn Arg Glu Val Ile
          35           40           45
Glu Tyr Phe Lys Glu His Val Asn Pro Gly Phe Leu Glu Tyr Arg Lys
          50           55           60
Ser Val Thr Ala Gly Gly Asp Tyr Gly Ala Val Glu Trp Gln Ala Gly
65           70           75           80
Ser Leu Asn Thr Leu Val Asp Thr Gln Gly Gln Glu Phe Ile Asp Cys
          85           90           95
Leu Gly Gly Phe Gly Ile Phe Asn Val Gly His Arg Asn Pro Val Val
          100          105          110
Val Ser Ala Val Gln Asn Gln Leu Ala Lys Gln Pro Leu His Ser Gln
          115          120          125
Glu Leu Leu Asp Pro Leu Arg Ala Met Leu Ala Lys Thr Leu Ala Ala
          130          135          140
Leu Thr Pro Gly Lys Leu Lys Tyr Ser Phe Phe Cys Asn Ser Gly Thr
145          150          155          160
Glu Ser Val Glu Ala Ala Leu Lys Leu Ala Lys Ala Tyr Gln Ser Pro
          165          170          175
Arg Gly Lys Phe Thr Phe Ile Ala Thr Ser Gly Ala Phe His Gly Lys
          180          185          190
Ser Leu Gly Ala Leu Ser Ala Thr Ala Lys Ser Thr Phe Arg Lys Pro
          195          200          205
Phe Met Pro Leu Leu Pro Gly Phe Arg His Val Pro Phe Gly Asn Ile
          210          215          220
Glu Ala Met Arg Thr Ala Leu Asn Glu Cys Lys Lys Thr Gly Asp Asp
225          230          235          240
Val Ala Ala Val Ile Leu Glu Pro Ile Gln Gly Glu Gly Gly Val Ile
          245          250          255
Leu Pro Pro Pro Gly Tyr Leu Thr Ala Val Arg Lys Leu Cys Asp Glu
          260          265          270
Phe Gly Ala Leu Met Ile Leu Asp Glu Val Gln Thr Gly Met Gly Arg

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275	280	285
Thr Gly Lys Met Phe Ala Cys	Glu His Glu Asn Val	Gln Pro Asp Ile
290	295	300
Leu Cys Leu Ala Lys Ala Leu	Gly Gly Gly Val Met Pro	Ile Gly Ala
305	310	315
Thr Ile Ala Thr Glu Glu Val	Phe Ser Val Leu Phe Asp	Asn Pro Phe
325	330	335
Leu His Thr Thr Thr Phe Gly	Gly Asn Pro Leu Ala Cys	Ala Ala Ala
340	345	350
Leu Ala Thr Ile Asn Val Leu	Leu Glu Gln Asn Leu Pro	Ala Gln Ala
355	360	365
Glu Gln Lys Gly Asp Met Leu	Leu Asp Gly Phe Arg Gln	Leu Ala Arg
370	375	380
Glu Tyr Pro Asp Leu Val Gln	Glu Ala Arg Gly Lys Gly	Met Leu Met
385	390	395
Ala Ile Glu Phe Val Asp Asn	Glu Ile Gly Tyr Asn Phe	Ala Ser Glu
405	410	415
Met Phe Arg Gln Arg Val Leu	Val Ala Gly Thr Leu Asn	Asn Ala Lys
420	425	430
Thr Ile Arg Ile Glu Pro Pro	Leu Thr Leu Thr Ile Glu	Gln Cys Glu
435	440	445
Leu Val Ile Lys Ala Ala Arg	Lys Ala Leu Ala Ala Met	Arg Val Ser
450	455	460
Val Glu Glu Ala		
465		
<210> 111		
<211> 456		
<212> PRT		
<213> 绿脓杆菌		
<400> 111		
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1	5	10
Ser Arg Asp His His Leu Pro	Pro Phe Thr Asp Tyr Lys	Gln Leu Asn
20	25	30
Glu Lys Gly Ala Arg Ile Ile	Thr Lys Ala Glu Gly Val	Tyr Ile Trp
35	40	45
Asp Ser Glu Gly Asn Lys Ile	Leu Asp Ala Met Ala Gly	Leu Trp Cys
50	55	60
Val Asn Val Gly Tyr Gly Arg	Glu Glu Leu Val Gln Ala	Ala Thr Arg

65	70	75	80
Gln Met Arg Glu Leu Pro Phe Tyr Asn Leu Phe Phe Gln Thr Ala His			
	85	90	95
Pro Pro Val Val Glu Leu Ala Lys Ala Ile Ala Asp Val Ala Pro Glu			
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	115	120	125
Thr Val Leu Arg Met Val Arg His Tyr Trp Ala Thr Lys Gly Gln Pro			
	130	135	140
Gln Lys Lys Val Val Ile Gly Arg Trp Asn Gly Tyr His Gly Ser Thr			
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Val Ala Gly Val Ser Leu Gly Gly Met Lys Ala Leu His Glu Gln Gly			
	165	170	175
Asp Phe Pro Ile Pro Gly Ile Val His Ile Ala Gln Pro Tyr Trp Tyr			
	180	185	190
Gly Glu Gly Gly Asp Met Ser Pro Asp Glu Phe Gly Val Trp Ala Ala			
	195	200	205
Glu Gln Leu Glu Lys Lys Ile Leu Glu Val Gly Glu Glu Asn Val Ala			
	210	215	220
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225	230	235	240
Pro Asp Thr Tyr Trp Pro Lys Ile Arg Glu Ile Leu Ala Lys Tyr Asp			
	245	250	255
Ile Leu Phe Ile Ala Asp Glu Val Ile Cys Gly Phe Gly Arg Thr Gly			
	260	265	270
Glu Trp Phe Gly Ser Gln Tyr Tyr Gly Asn Ala Pro Asp Leu Met Pro			
	275	280	285
Ile Ala Lys Gly Leu Thr Ser Gly Tyr Ile Pro Met Gly Gly Val Val			
	290	295	300
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	325	330	335
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	370	375	380

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Gln Gly Glu Gly Gly Phe Tyr Ala Ser Ser Pro Ala Phe Met Gln Arg		
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Leu Arg Ala Leu Cys Asp Glu His Gly Ile Met Leu Ile Ala Asp Glu		
225	230	235
Val Gln Ser Gly Ala Gly Arg Thr Gly Thr Leu Phe Ala Met Glu Gln		
	245	250
Met Gly Val Ala Pro Asp Leu Thr Thr Phe Ala Lys Ser Ile Ala Gly		
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Gly Phe Pro Leu Ala Gly Val Thr Gly Arg Ala Glu Val Met Asp Ala		
	275	280
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		30

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				85				90				95			
Pro	Val	Ser	Gly	Gln	Ala	Lys	Thr	Ala	Phe	Phe	Thr	Thr	Gly	Ala	Glu
				100				105				110			
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				115				120				125			
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Ile Gly Tyr Ile Cys Arg Glu	Arg Cys Phe Ala Asn	Asn Leu Ile Met
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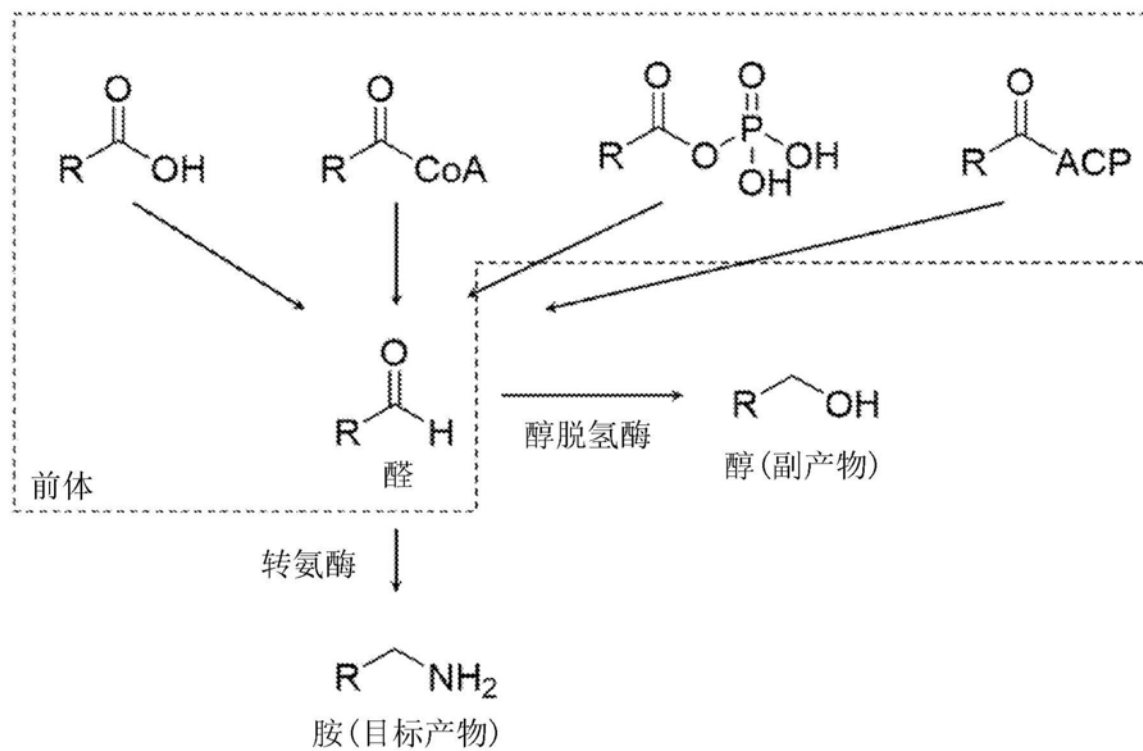


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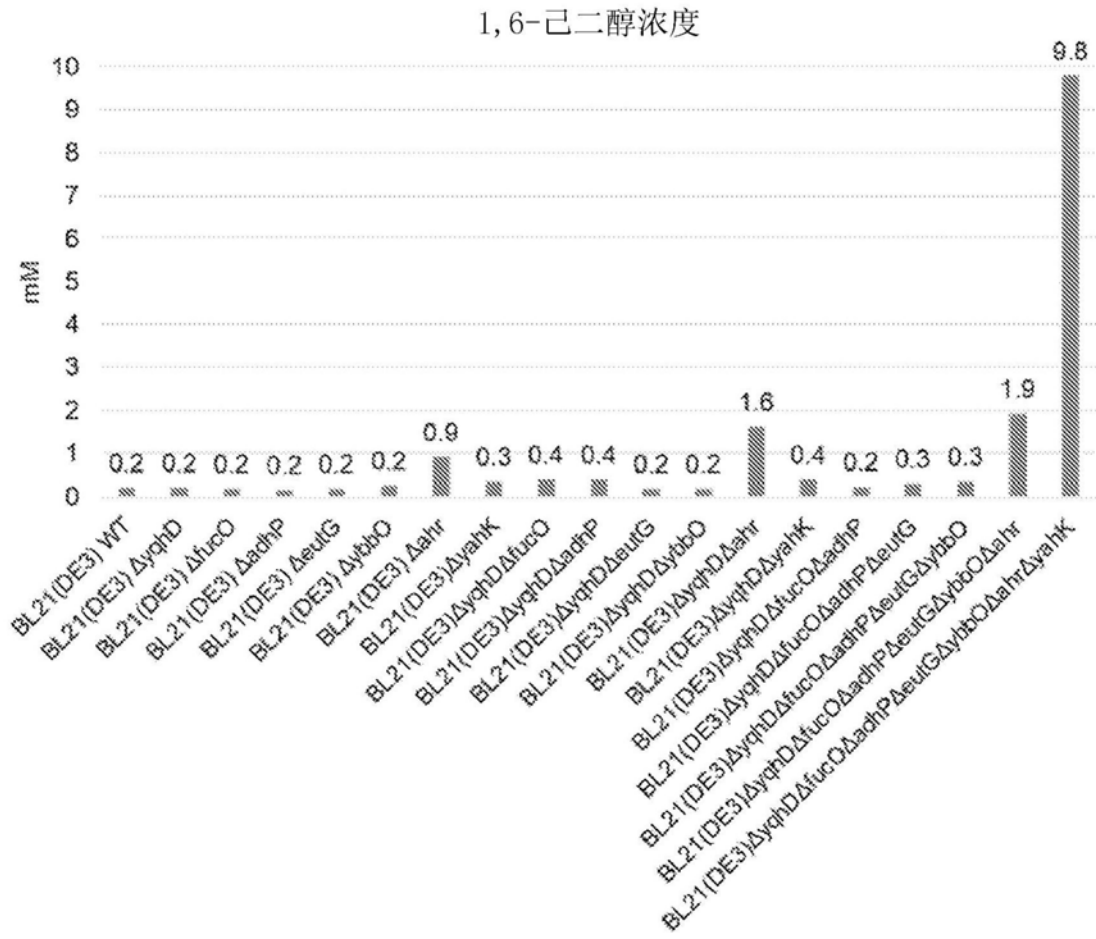


图2

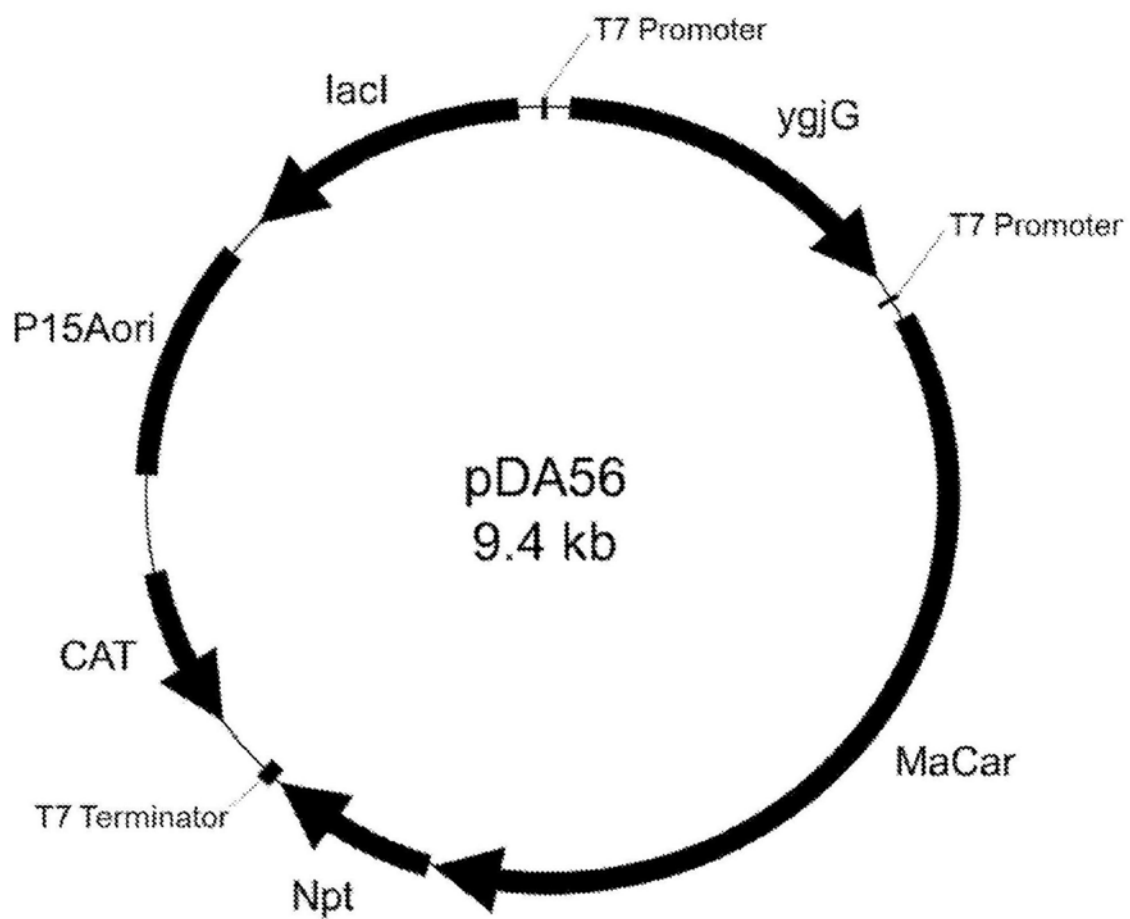


图3