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Title: Beta-Lactamase Genes in Soil Bacteria Isolated from the Banks of the Niangua River in Missouri

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Beta-lactam antibiotics are among the most widely prescribed antibiotics in clinical settings. As a result, it is not uncommon to encounter clinically isolated bacteria that produce beta-lactamase as a means of resistance to these antibiotics. Among the many beta-lactamases currently known, TEM-type beta-lactamase is the most widespread beta-lactamase observed in clinical settings. However, less is known regarding its prevalence among bacteria in natural settings. To determine how widespread the TEM-type beta-lactamase gene is in the environment, experiments were designed to detect this and other beta-lactamase genes from environmentally isolated bacteria. Briefly, soil was collected along the banks of the Niangua River located in west-central Missouri. Diluted soil preparations were plated onto tryptic soy agar plates containing ampicillin and allowed to incubate at room temperate for up to 14 days. Colonies (n = 58) growing on the plates were selected and total DNA isolated from each strain. Using 7 groups of beta-lactamase specific DNA primers, the polymerase chain reaction was employed to amplify beta-lactamase genes, if present. In total, 58 isolates were positive for an 800 base pair amplicon indicative of a TEM-type beta-lactamase. DNA sequencing of the

amplified fragment from each strain was sequenced to identify the TEM variant present. The data indicated that TEM-116 beta-lactamases are widespread among natural populations of bacteria from this location. In total, 56 of the genes were TEM-116, 1 was TEM-1, and 1 was TEM-118. These genes were most predominate in the genera *Bacillus* and *Pseudomonas*. Attempts to transfer the resistance genes via transformation and conjugation were unsuccessful.

BETA-LACTAMASE GENES IN SOIL BACTERIA ISOLATED FROM THE BANKS OF THE NIANGUA RIVER IN MISSOURI

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PREFACE

This thesis was prepared following the publication style of the American Society for Microbiology.

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Introduction

Antibiotics are medicinal products that inhibit bacterial growth or kill infectious organisms. Beta-lactam antibiotics are among the most widely prescribed antibiotics in clinical settings and include the penicillins, cephalosporins, carbapenems, and monobactams (26). While slightly distinct in their mechanism of action, they all contain a beta-lactam ring structure which inhibits bacterial cell wall biosynthesis. Indeed, 60 percent of all currently used antibiotics belong to the beta-lactam family (48), with the penicillins and cephalosporins predominating (23).

In clinical settings, many infectious organisms have developed resistance to antibiotics because of inappropriate use (17). Oftentimes, bacterial resistance to beta-lactam antibiotics is due to the synthesis of a beta-lactamase, an enzyme that attacks and destroys the beta-lactam ring (25). The constant overuse of beta-lactam antibiotics has caused mutation, resulting in more than 1000 different beta-lactamases being described (22). As a result, it is not uncommon to encounter clinically isolated bacteria that produce beta-lactamase as a means of resistance to these antibiotics.

Beta-lactamases can be divided into several types based on their functional activity and molecular structure (12), with TEM, SHV, CTX-M, and OXA predominating. Among these, TEM beta-lactamases are the most widespread in clinical settings (2, 11). The first TEM beta-lactamase described, TEM-1, was isolated from a penicillin-resistant bacterium in the 1960s (16). To date, 208 TEM-type variants have been reported (see http://www.lahey.org/Studies/temtable.asp; May, 2013).

TEM variants differ in amino acid sequence because of genetic mutations, which change their antibiotic resistance spectrum (8, 13). Figure 1 shows the distribution of known mutations in amino acid sequence of TEM-1 beta-lactamase, leading to the different variants. Among all of the 208 beta-lactamases, TEM-10, TEM-12, and TEM-26 are the most common in the United States (10, 28, 37). Clinically, TEM-type beta-lactamases predominate in *Escherichia coli* and *Klebsiella pneumoniae* (42). Because many beta-lactamase genes are plasmid encoded (49), this aids mobilization, leading to increased distribution among other bacterial species (24).

While clinical research regarding antibiotic resistance is on-going, antibiotic resistance research in the natural environment has been overlooked. Although most resistance determinants have been found in either clinical or laboratory settings, antibiotic resistance genes may come directly from the environment (4). A changing environment likely facilitates the emergence of new resistance genes and their transfer to humans. Thus, understanding antibiotic resistance in natural environments may help predict and possibly counteract the emergence and future evolution of antibiotic resistance in clinical settings (32, 43).

To aid our understanding of environmental antibiotic resistance, a study was initiated with the objective of determining how widespread beta-lactamase genes are in the environment. To address this question, soil was collected along the banks of the Niangua River located in west-central Missouri. Ampicillin resistant bacteria were isolated and screened for the presence of beta-lactamase genes. Our data suggests that

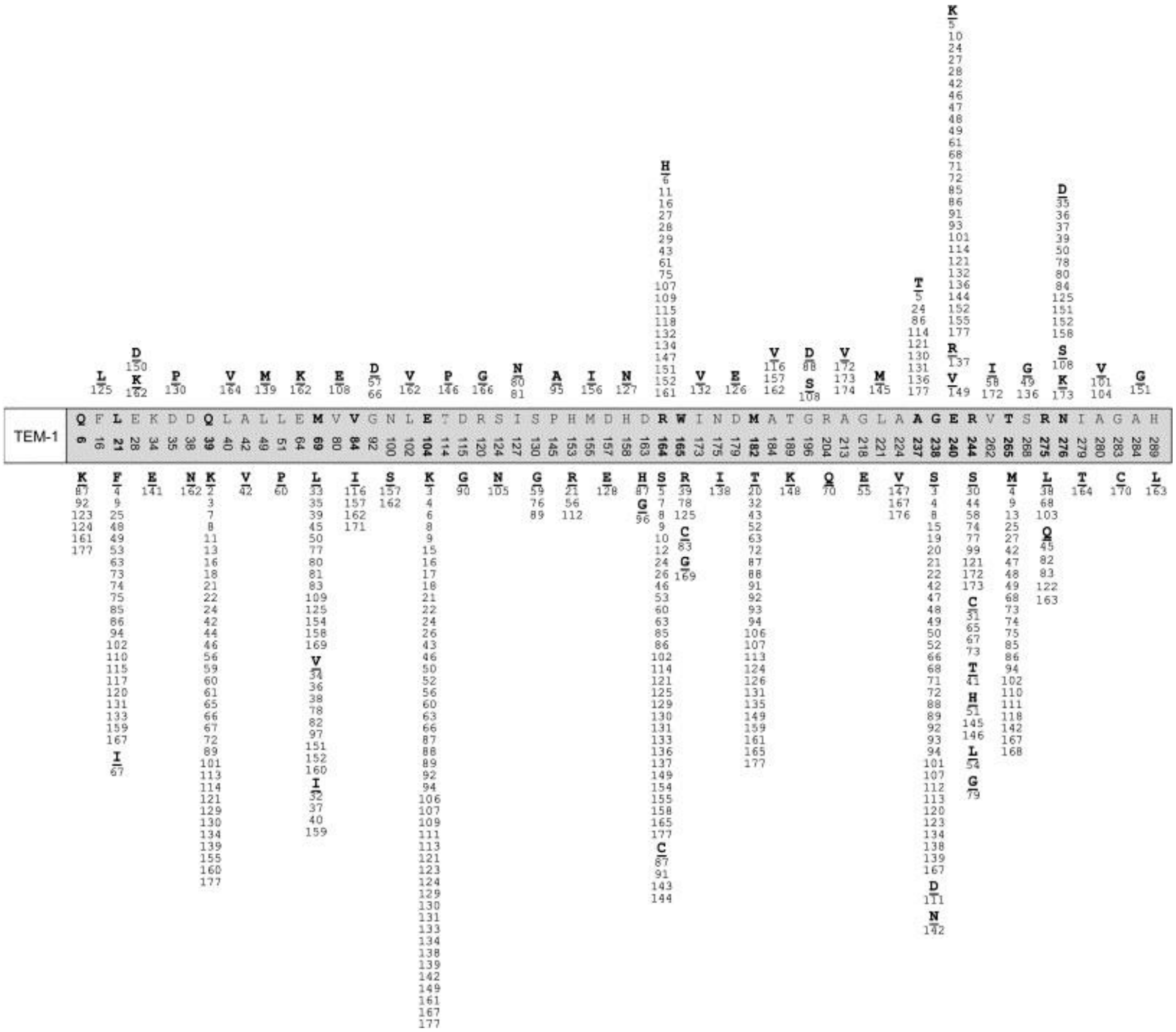
TEM-1

Figure 1. Positions and Types of Amino Acid Substitutions in TEM Type Beta-Lactamases (44). This figure illustrates 177 different variants. Since its publication, the number of TEM variants has risen to 208.

TEM type beta-lactamases, specifically TEM-116, are widespread among natural populations of both Gram positive and Gram negative bacteria from this location.

Materials and Methods

Sample Collection

Soil samples were collected along the banks of the Niangua River, located in west-central Missouri, in August 2011. Samples were stored at 4°C for 1 week until processing.

Isolation of Ampicillin Resistant Bacterial Strains

Soil samples were suspended in 10 ml of phosphate buffered saline (PBS). Vortexing was used to mix the sample. Serial 1:10 dilutions were accomplished using PBS until a final dilution of 1:100 was obtained. 100 µl of the 1:100 diluted sample was spread plated onto Luria-Bertani (10 g tryptone, 10 g yeast extract, 5 g NaCl/L) agar (15 g/L) containing 100 µg/ml ampicillin. Plates were incubated at 30 °C for up to 14 days and representative colonies (n = 58) were picked from each plate for further analysis.

Isolation of Total DNA and Plasmid DNA

Bacterial isolates were propagated in 5 ml LB at 37°C with shaking (200 rpm) overnight. Cell pellets obtained after centrifugation in a microcentrifuge at full speed were resuspended in 1ml of TE (10mM Tris, 1mM EDTA; pH8) containing 10 mg/ml lysozyme. After incubation at 37 °C for 30 min, total DNA was obtained using a Zymo Research Quick-gDNA™ MicroPrep kit (Zymo Research, Irvine, CA) according to the manufacturer’s instructions. Plasmid DNA was obtained from each isolate using a Zymo Research Plasmid MiniPrep kit (Zymo Research, Irvine, CA) according to the manufacturer’s instructions.

Multiplex Polymerase Chain Reaction

DNA from each ampicillin resistant isolate was used as a template to amplify beta-lactamase genes in a multiplex PCR according to the methodology described by Dallenne et al. (15). Primers and amplification conditions are outlined in Table 1. Briefly, reaction mixtures were composed of 100 ng of total DNA, multiplex primers, dNTP's, Phusion High-Fidelity DNA Polymerase, and its buffer (Thermo Scientific, Rockford, IL) in a total volume of 100 μL. Amplification was carried out on a T100 Thermal Cycler (Bio-Rad, Hercules, CA).

16S rRNA Polymerase Chain Reaction

DNA from each ampicillin resistant isolate was used as a template to amplify the 16S rRNA gene (21). Primers consisted of the 8F primer (5'AGAGTTTGATCCTGGCTCAG3') and 1492R(L) primer (5'GGTTACCTT GTTACGACTT3'). Reaction mixtures were composed of 100 ng of total DNA, 8F and 1492R(L) primers, 200 μM of dNTP's, 1 U of Phusion High-Fidelity DNA Polymerase (Thermo Scientific) and its buffer in a total volume of 50 μL. Amplification was carried out on a T100 Thermal Cycler (Bio-Rad, Hercules, CA) using the following conditions: initial denaturation at 94 °C for 5 min; 30 cycles of 94 °C for 1 min, 50 °C for 1 min and 72 °C for 1.5 min; and a final elongation step at 72 °C for 7 min.

Table 1. Primers and Amplifications Conditions Used in this Study.*

PCR name	Beta-Lactamase targeted	Primer name	Sequence (5'→3')	Amplicon Size (bp)	Amplification Conditions
Multiplex I TEM, SHV and OXA-1-like	TEM variants including TEM-1 and TEM-2	MultiTSO-T_for	CATTTCCGTGTCGCCCTTATTC	800	94 °C for 10 min; 30 cycles of 94 °C for 40 s, 60 °C for 40 s and 72 °C for 1 min; 72 °C for 7 min.
		MultiTSO-T_rev	CGTTCATCCATAGTTGCCTGAC		
	SHV variants including SHV-1	MultiTSO-S_for	AGCCGCTTGAGCAAATTAAAC	713	
		MultiTSO-S_rev	ATCCCGCAGATAAATCACCAC		
	OXA-1, OXA-4 and OXA-30	MultiTSO-O_for	GGCACCAGATTCAACTTTCAAG	564	
		MultiTSO-O_rev	GACCCCAAGTTTCCTGTAAGTG		
Multiplex II CTX-M group 1, group 2 and group 9	Variants of CTX-M group 1 including CTX-M-1, CTX-M-3 and CTX-M-15	MultiCTXMGp1_for	TTAGGAARTGTGCCGCTGYA**	688	
		MultiCTXMGp1-2_rev	CGATATCGTTGGTGGTRCCAT**		
	Variants of CTX-M group 2 including CTX-M-2	MultiCTXMGp2_for	CGTTAACGGCACGATGAC	404	
		MultiCTXMGp1-2_rev	CGATATCGTTGGTGGTRCCAT**		
	Variants of CTX-M group 9 including CTX-M-9 and CTX-M-14	MultiCTXMGp9_for	TCAAGCCTGCCGATCTGGT	561	
		MultiCTXMGp9_rev	TGATTCTCGCCGCTGAAG		
CTX-M group 8/25	CTX-M-8, CTX-M-25, CTX-M-26 and CTX-M-39 to CTX-M-41	CTX-Mg8/25_for	AACRCRCAGACGCTCTAC**	326	
		CTX-Mg8/25_rev	TCGAGCCGGAASGTGTYAT**		
Multiplex III ACC, FOX, MOX, DHA, CIT and EBC	ACC-1 and ACC-2	MultiCaseACC_for	CACCTCCAGCGACTTGTTAC	346	
		MultiCaseACC_rev	GTTAGCCAGCATCACGATCC		
	FOX-1 to FOX-5	MultiCaseFOX_for	CTACAGTGCGGGTGGTTT	162	
		MultiCaseFOX_rev	CTATTTGCGGCCAGGTGA		
	MOX-1, MOX-2, CMY-1, CMY-8 to CMY-11 and CMY-19	MultiCaseMOX_for	GCAACAACGACAATCCATCCT	895	
		MultiCaseMOX_rev	GGGATAGGCGTAACTCTCCCAA		
	DHA-1 and DHA-2	MultiCaseDHA_for	TGATGGCACAGCAGGATATTC	997	
		MultiCaseDHA_rev	GCTTTGACTCTTTCGGTATTCG		

	LAT-1 to LAT-3, BIL-1, CMY-2 to CMY-7, CMY-12 to CMY-18 and CMY-21 to CMY-23	MultiCaseCIT_for	CGAAGAGGCAATGACCAGAC	538	
		MultiCaseCIT_rev	ACGGACAGGGTTAGGATAGY**		
	ACT-1 and MIR-1	MultiCaseEBC_for	CGGTAAAGCCGATGTTGCG	683	
		MultiCaseEBC_rev	AGCCTAACCCCTGATACA		
Multiplex IV VEB, PER and GES	GES-1 to GES-9 and GES-11	MultiGES_for	AGTCGGCTAGACCGGAAAG	399	
		MultiGES_rev	TTTGTCCGTGCTCAGGAT		
	PER-1 and PER-3	MultiPER_for	GCTCCGATAATGAAAGCGT	520	
		MultiPER_rev	TTCGGCTTGACTCGGCTGA		
	VEB-1 to VEB-6	MultiVEB_for	CATTTCCCGATGCAAAGCGT	648	
		MultiVEB_rev	CGAAGTTTCTTTGGACTCTG		
Multiplex V GES and OXA-48-like	GES-1 to GES-9 and GES-11	MultiGES_for	AGTCGGCTAGACCGGAAAG	399	94 °C for 10 min; 30 cycles of 94 °C for 40 s, 57 °C for 40 s and 72 °C for 1 min; 72 °C for 7 min.
		MultiGES_rev	TTTGTCCGTGCTCAGGAT		
	OXA-48-like	MultiOXA-48_for	GCTTGATCGCCCTCGATT	281	
		MultiOXA-48_rev	GATTTGCTCCGTGGCCGAAA		
Multiplex VI IMP, VIM and KPC	IMP variants except IMP-9, IMP-16, IMP-18, IMP-22 and IMP-25	MultiIMP_for	TTGACACTCCATTTACDG**	139	94 °C for 10 min; 30 cycles of 94 °C for 40 s, 55 °C for 40 s and 72 °C for 1 min; 72 °C for 7 min.
		MultiIMP_rev	GATYGAGAATTAAGCCACYCT**		
	VIM variants including VIM-1 and VIM-2	MultiVIM_for	GATGGTGTTTGGTCGCATA	390	
		MultiVIM_revc	CGAATGCGCAGCACCAG		
	KPC-1 to KPC-5	MultiKPC_for	CATTCAAGGGCTTTCTTGCTGC	538	
		MultiKPC_rev	ACGACGGCATAGTCATTTGC		

*(Dallenne et al., 2010)

**Y=T or C; R=A or G; S=G or C; D=A or G or T.

Agarose Gel Electrophoresis

To effectively separate DNA fragments of various sizes, agarose gel electrophoresis was employed according to standard conditions (46). Briefly, 30 ml of 1X TAE buffer prepared from a 50X TAE stock (242 g Tris, 57.1 ml acetic acid, and 4 ml 0.5 M EDTA in 1 L of H_2O), 0.3 g of agarose, and 2 μl of 10 mg/ml ethidium bromide (EtBr) were mixed and heated in the microwave until the agarose dissolved. The mixture was poured into a gel casting tray containing a gel comb. After solidification, the comb was removed and 1X TAE buffer was added to completely cover the gel. Subsequently, DNA samples were mixed with loading buffer, loaded into the wells, and electrophoresed using a Bio-Rad model 250/2.5 power supply (Bio-Rad), at ~100 volts for 30-40 min. DNA was visualized after electrophoresis using a UV Intensity Transilluminator (Fisher Scientific™; St. Louis, MO).

Purification of DNA from Agarose Gels

DNA was excised from electrophoresed gels using a razor blade and purified using a Zymoclean™ Gel DNA Recovery Kit (Zymo Research) according to the manufacturer's instructions.

Determination of DNA Concentration

DNA concentration was measured using a nanodrop spectrophotometer (Thermo Scientific, Rockford, IL). Briefly, according to the manufacturer's instructions, after blanking the instrument using sterile water at λ=260 nm, the concentration of the DNA sample was determined.

DNA Sequencing and BLAST Analysis

Purified DNA amplicons were submitted to the DNA Sequencing Facility at the University of Arkansas for Medical Sciences (Dept. Microbiology/Immunology, Little Rock, AR) for DNA sequence determination. The Basic Local Alignment Search Tool (BLAST) (5) was used to analyze the sequenced DNA.

Preparation of Competent Cells

Escherichia coli TG1 was grown in 2X LB medium at 30 °C overnight with shaking at 250 rpm. Subsequently, 0.5 ml of overnight culture was used to inoculate 200 ml of fresh 2X LB in a flask at 30 °C with shaking. When the OD_{600} of the culture reached 0.3, 4 ml of 1M $MgCl_2$ was added and incubation continued until an OD_{600} of 0.45-0.55 was obtained. The culture was placed on ice for 2 hrs prior to centrifugation at 3000 rpm at 4 °C for 5 min in a J2-HS centrifuge (Beckham Coulter Inc; Brea, CA). The cell pellet was resuspended in 100 mM $CaCl_2$ media (0.05 M $CaCl_2$, 0.04 M $MnCl_2$, and 0.02 M CH_3COON, 4°C, pH7.5). After incubation on ice for 40 min, cells were pelleted again by centrifugation and resuspended in fresh ice-cold 100 mM $CaCl_2$ media containing 15% glycerol. Competent cells were stored in 100 μl aliquots at -80 °C.

Transformation

Transformation was used to transfer ampicillin resistance into competent *E. coli* TG1. Briefly, 100 ng of plasmid DNA isolated from an ampicillin resistant isolate was mixed with 100 μl competent *Escherichia coli* TG1 cells and put on ice for 15 min. Subsequently, incubation at 42 °C for 90 s followed by ice for 60 s was performed. 900

µl LB liquid media was added to each culture and after incubation for 45 min at 37 °C, 100 µl was spread plated onto a LB/ampicillin (100 µg/ml) agar plate and incubated overnight at 37 °C.

Conjugation

Conjugation was used in an attempt to transfer ampicillin resistance from an ampicillin resistant isolate to recipient *Escherichia coli* HWS174. Briefly, environmental isolates (donor) and *Escherichia coli* HWS174 (recipient) were grown overnight at 37 °C with shaking at 200 rpm. A 50 µl aliquot was transferred to fresh LB media and incubation continued until a 0.5 McFarland turbidity standard was obtained. 500 µl of the donor strain was mixed with 500 µl of the recipient strain followed by incubation at 37 °C for 90 min. Subsequently, 100 µl of the conjugated culture was plated on LB agar containing ampicillin (100 µg/ml) and rifampicin (100 µg/ml) followed by incubation overnight at 37°C.

Results

Amplification of Beta-lactamase Genes via Multiplex PCR

Using seven multiplex PCRs (15), total DNA isolated from 58 different ampicillin resistant bacterial strains was analyzed for the presence of beta-lactamase genes as outlined in Table 2. The TEM multiplex reaction yielded an amplification product in all 58 strains (Figure 2). All other multiplex reactions were negative (data not shown).

DNA Sequencing and BLAST Analysis of TEM-type Beta-Lactamase Genes

The TEM-type beta-lactamase gene amplified from all 58 strains was subjected to DNA sequencing. Each gene was sequenced three times in both directions. Data obtained was subjected to the Basic Local Alignment Search Tool (BLAST) (5) to identify each TEM-type beta-lactamase gene. Our data indicated 56 of the genes were TEM-116, 1 was TEM-1, and 1 was TEM-118. This data is summarized in Table 2 and Appendix 1.

Amplification of 16S rRNA Gene

Using primers 8F and 1492R (L) (21), the 16S rRNA gene was amplified from chromosomal DNA templates prepared from the 58 ampicillin resistant strains via PCR. Subsequently, DNA sequencing followed by BLAST analysis were used to make a tentative identification at the genus level. This data is summarized in Table 2. The DNA sequence of the 16S rRNA gene used for analysis is presented in Appendix 2.

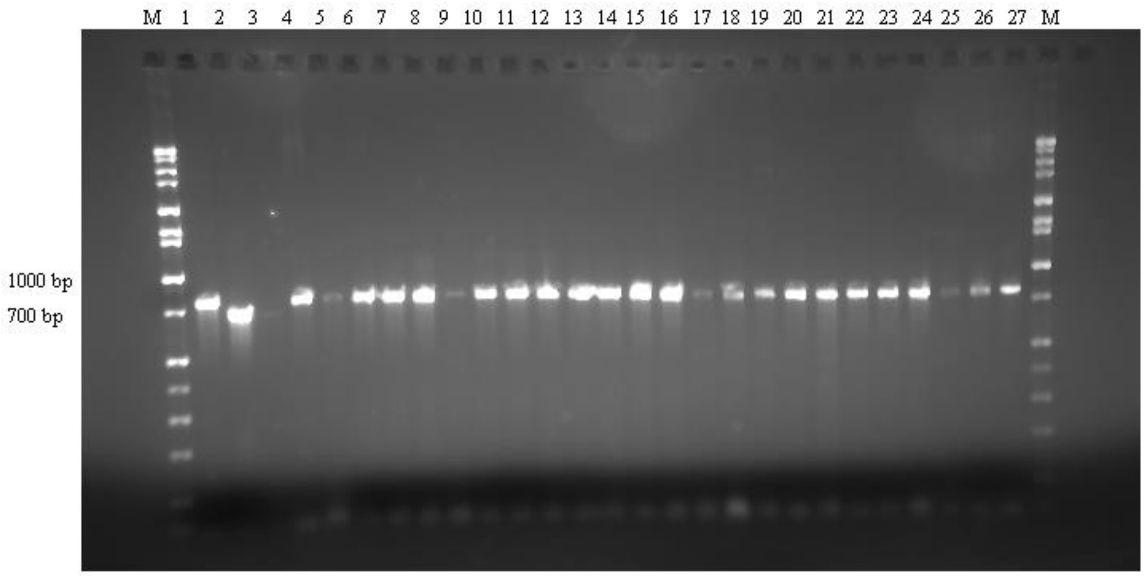
M 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 M
1000 bp
700 bp

Figure 2. Representative Agarose Gel Showing Amplification of the TEM-type Beta-Lactamase Gene. DNA was complified using Multiplex I TEM, SHV and OXA-1-like primers. M - DNA Marker, Lane 1, 2 - Positive control (1. *Escherichia coli* 5667, TEM positive; 2. *Klebsiella pneumonia*e 5585, SHV positive), Lane 3 - Blank, Lane 4-27 - Total DNA from bacteria isolated in this study. Gel shown is representative of 3 additional agarose gels containing amplified TEM - type beta-lactamases from the remaining bacteria isolated in this study.

Table 2. Summary of BLAST Analysis Using DNA Sequencing from 16S rRNA and TEM-type Beta-Lactamase Genes.

Isolate	Strain Name	Genus	GenBank	Identity	TEM-
1	NRCJ-1	*Pseudomonas*	NR_025228.1	98%	116
2	NRCJ-2	*Pseudomonas*	NR_025228.1	98%	116
3	NRCJ-3	*Pseudomonas*	NR_025228.1	98%	116
4	NRCJ-4	*Stenotrophomonas*	NR_028930.1	99%	116
5	NRCJ-5	*Pseudomonas*	NR_043314.1	99%	116
6	NRCJ-6	*Nocardioides*	NR_040938.1	96%	116
7	NRCJ-7	*Pseudomonas*	NR_043314.1	99%	116
8	NRCJ-8	*Pseudomonas*	NR_028906.1	99%	116
9	NRCJ-9	*Pseudomonas*	NR_024918.1	99%	116
10	NRCJ-10	*Stenotrophomonas*	NR_028930.1	99%	116
11	**NRCJ-11**	***Curtobacterium***	**NR_025467.1**	**97%**	**181**
12	NRCJ-12	*Curtobacterium*	NR_042315.1	95%	116
13	NRCJ-13	*Pseudomonas*	NR_041953.1	97%	116
14	**NRCJ-14**	***Pseudomonas***	**NR_074834.1**	**99%**	**1**
15	NRCJ-15	*Pseudomonas*	NR_074834.1	95%	116
16	NRCJ-16	*Pseudomonas*	NR_041953.1	97%	116
17	NRCJ-17	*Bacillus*	NR_043403.1	99%	116
18	NRCJ-18	*Pseudomonas*	NR_025227.1	84%	116
19	NRCJ-19	*Pseudomonas*	NR_028906.1	99%	116
20	NRCJ-20	*Stenotrophomonas*	NR_074875.1	99%	116
21	NRCJ-21	*Pseudomonas*	NR_040859.1	99%	116
22	NRCJ-22	*Stenotrophomonas*	NR_041577.1	86%	116
23	NRCJ-23	*Pseudomonas*	NR_041953.1	99%	116
24	NRCJ-24	*Pseudomonas*	NR_041953.1	99%	116
25	NRCJ-25	*Pseudomonas*	NR_028906.1	97%	116
26	NRCJ-26	*Pseudomonas*	NR_024902.1	94%	116
27	NRCJ-27	*Pseudomonas*	NR_024662.1	99%	116
28	NRCJ-28	*Pseudomonas*	NR_025228.1	94%	116
29	NRCJ-29	*Pseudomonas*	NR_028906.1	99%	116
30	NRCJ-30	*Lysobacter*	NR_036925.1	94%	116
31	NRCJ-31	*Bacillus*	NR_043403.1	88%	116
32	NRCJ-32	*Bacillus*	NR_043403.1	97%	116
33	NRCJ-33	*Bacillus*	NR_043403.1	98%	116
34	NRCJ-34	*Bacillus*	NR_043403.1	99%	116
35	NRCJ-35	*Lysinibacillus*	NR_042072.1	95%	116
36	NRCJ-36	*Bacillus*	NR_043403.1	98%	116
37	NRCJ-37	*Bacillus*	NR_043403.1	98%	116
38	NRCJ-38	*Bacillus*	NR_043403.1	98%	116
39	NRCJ-39	*Pseudomonas*	NR_041953.1	99%	116

40	NRCJ-40	***Sphingobacterium***	NR_040953.1	96%	116
41	NRCJ-41	*Pseudomonas*	NR_041953.1	99%	116
42	NRCJ-42	***Cupriavidus***	NR_028766.1	88%	116
43	NRCJ-43	*Pseudomonas*	NR_043935.1	99%	116
44	NRCJ-44	*Pseudomonas*	NR_025228.1	84%	116
45	NRCJ-45	***Bacillus***	NR_043403.1	99%	116
46	NRCJ-46	***Isoptericola***	NR_025439.1	99%	116
47	NRCJ-47	***Bacillus***	NR_043403.1	97%	116
48	NRCJ-48	*Pseudomonas*	NR_025881.1	95%	116
49	NRCJ-49	*Pseudomonas*	NR_024662.1	99%	116
50	NRCJ-50	*Pseudomonas*	NR_024662.1	99%	116
51	NRCJ-51	***Bacillus***	NR_043403.1	97%	116
52	NRCJ-52	***Stenotrophomonas***	NR_041577.1	99%	116
53	NRCJ-53	*Pseudomonas*	NR_026532.1	98%	116
54	NRCJ-54	*Pseudomonas*	NR_025228.1	99%	116
55	NRCJ-55	***Curtobacterium***	NR_042315.1	97%	116
56	NRCJ-56	*Pseudomonas*	NR_024662.1	98%	116
57	NRCJ-57	***Shigella***	NR_026331.1	99%	116
58	NRCJ-58	*Pseudomonas*	NR_028906.1	98%	116

*Isolates harboring TEM-1 and TEM-118 genes are in bold.

Discussion

Since antibiotic usage is commonplace throughout all aspects of human society, it is inevitable that residual amounts will be present in the environment and continuously work as selective agents for the development of environmental antibiotic resistance (31). The first antibiotic was found in 1928. In the 80 plus years since, numerous antibiotics have been discovered for which resistance soon followed. To aid our understanding of environmental antibiotic resistance, it is important to determine what type of resistance is present. As a step toward this goal, this study has focused on beta-lactamase resistance.

Ampicillin is a beta-lactam antibiotic belonging to the penicillin family and is the successor of penicillin, one of the more predominating antibiotics in today's world. Utilizing bacteriological media containing ampicillin, 58 bacterial isolates were obtained from soil located along the banks of the Niangua River in west-central Missouri. Beta-lactamases are produced at high concentrations by certain Gram-positive organisms, and in particular *Bacillus cereus* (30), *Bacillus licheniformis* (7) and *Staphylococcus aureus* (34). The enzyme is also widely distributed in Gram-negative organisms and many different variations of beta-lactamases can be recognized on the grounds of activity towards different beta-lactams (33). The molecular classification of beta-lactamases is based on the amino acid sequence of these enzymes. To date, four classes are recognized (A-D), correlating with a functional classification. Classes A, C, and D act by a serine-based mechanism, whereas class B (also called metallo-beta-lactamases) need zinc for their action (6).

Resistance to beta-lactam antibiotics is an increasing problem, commonly due to the production of beta-lactamases (20). To investigate the mechanism of resistance observed in the ampicillin resistant isolates obtained in this study, it was hypothesized that beta-lactamase genes could be detected. Following the assay descripted by Dallenne et al. (15), seven groups of primers were utilized to amplify the most frequently encountered beta-lactamases genes. All 58 isolates were positive for TEM type beta-lactamases genes (Figure 2).

Several TEM type beta-lactamases have been identified in laboratory studies before their identification in clinical isolates (9, 51). Figure 1 shows all the amino acid substitutions in TEM type beta-lactamase genes. One or more amino acid substitutions around the active site result in extended-spectrum beta-lactamases, which demonstrate broad resistance to penicillins, aztreonam, and cephalosporins (38). Salverda et al. (45) overviewed the frequency of substitutions found at different positions within the TEM-1 amino acid sequence of clinical and laboratory isolates. The results demonstrated not all of the substitutions necessarily confer increased resistance and some substitutions, such as Alanine to Valine at position 184, are frequent in the laboratory but not currently present in clinical isolates. Investigating beta-lactamases in the environment or laboratory has direct clinical relevance because they may reveal novel phenotypes that could arise in clinical isolates. In this study, three types of TEM type beta-lactamases genes were identified; TEM-116 (n = 56), TEM-1 (n = 1), and TEM-181 (n = 1). Table 3 shows the amino acid positions of the substitutions among these three types of beta-lactamase.

TEM-1 beta-lactamase is the most prevalent beta-lactamase found in Gram-negative bacteria and is capable of hydrolyzing both penicillin and cephalosporin (6). Indeed, up to 90% of all ampicillin resistance noted in *E. coli* is due to the production of TEM-1 (14). TEM-116 was first and most prevalently identified from clinical isolates of *Klebsiella pneumoniae* and *Escherichia coli* from a Korean nationwide survey (29). The amino acid replacement at position 84 and 184 have not been observed in other TEM type beta-lactamases. In a study of resistance analyzing extended-spectrum cephalosporins in clinical *Escherichia coli* isolates from companion animals in the United States, Shaheen et al. (47) analyzed the structural difference between wild-type TEM-1 and TEM-181 beta-lactamases. DNA sequence analysis results suggested there might be a scheme for *in vivo* evolution: from TEM-1 to TEM-181, and from TEM-181 to TEM-116. The current study did not attempt to address this issue. (Table 3).

Many resistance genes are carried on transposable elements, such as transposons, integrons, and plasmids, and can be transferred to other bacteria (1, 39, 40, 50) though horizontal gene transfer. Murray and Mederski-Samaroj (35) reported penicillin resistance and beta-lactamase activity could be transferred by conjugation at a high frequency to an enterococcal laboratory recipient strain, demonstrating the emergence of plasmid-mediated penicillin resistance in the genus *Streptococcus*. Elwell et al. (24) also showed that R plasmids encoding beta-lactamase activity contained about 40% of all transposable ampicillin resistance. Recently, Dierikx et al. (24) tested the transfer of resistance plasmids by conjugation and transformation experiments and found IncI1

Table 3. Amino Acid Substitutions among the Three Types of Beta-Lactamase Genes Identified in this Study.

ß-Lactamase	**Residue (coding triplet) at amino acid**	
	84	**184**
TEM-1	Val (GTA)	Ala (GCA)
TEM-116	Ile (ATT)	Val (GTA)
TEM-181	Val (GTA)	Val (GTA)

plasmids containing blaCTX-M-1 can spread in *E. coli* and *Salmonella enterica* isolates. Doi et al. (19) confirmed the contribution of horizontal gene transmission of beta-lactamase genes among *E. coli* and *K. pneumonia*.

To determine the genetic location of the TEM beta-lactamase resistance in the 58 ampicillin resistant isolates from this study, transformation and conjugation experiments were performed. For conjugation, the recipient cell was *E. coil* HWS174 (rifampicin resistance), while the donor cell (environmental isolates) is resistant to ampicillin. After co-incubation of the donor and recipient, if beta-lactamase genes are located on a conjugatable plasmid of the donor cells, it will be transferred to *E. coil* HWS174, which is noted by its growth on bacteriological media containing both rifampicin and ampicillin. However, no colonies were found on the plates, suggesting beta-lactamase genes are not located on the conjugatable plasmid of the donor cells. Alternatively, plasmids with TEM genes may have been transferred, but the beta-lactamase genes were not expressed. Control experiments demonstrated *E. coil* HWS174 was well suited as a recipient cell in conjugation assays (data not shown).

For transformation experiments, competent *E. coli* TG1 served as the recipient strain and isolated plasmid DNA from each ampicillin resistant bacterium was used as transforming DNA. If beta-lactamase genes are located on the plasmid of the donor cells and can be transformed into *E. coli*, colonies will form on ampicillin containing medium. No colonies were found. As with the conjugation studies, no attempt was made to determine if plasmids were transferred but TEM genes not expressed. Control experiments showed competent *E. coil* TG1 was a suitable recipient cell in transformation experiments (data not shown). Taken together, the data suggest a chromosomal location of the TEM genes or a lack of plasmid gene expression. If the TEM genes are not expressed, other mechanisms may account for the beta-lactam resistance, such as efflux pumps (36); inactivation of the antibiotic itself (41), inhibition of antibiotic uptake (3) or down-regulation of the cell target molecule (27).

In conclusion, beta-lactam resistance is widespread among soil bacteria from the banks of the Niangua River. All 58 organisms resistant to ampicillin contained TEM-type beta-lactamases, with TEM-116 predominating from the genera *Bacillus* and *Pseudomonas*. Attempts to transfer the resistance genes via transformation and conjugation were unsuccessful. This study highlights the presence of antibiotic resistance in the environment without direct antibiotic exposure and reinforces the need for continued surveillance of antibiotic resistance in natural settings.

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Appendix 1

DNA Sequence of TEM-type Beta-Lactamase Genes Identified in This Study

(5 ’→3’)

TEM-1

CATTTCCGTGTCGCCCTTATTCCCTTTTTTGCGGCATTTTGCCTTCCTGTTTTTG
CTCACCCAGAAACGCTGGTGAAAGTAAAAGATGCTGAAGATCAGTTGGGTGC
ACGAGTGGGTTACATCGAACTGGATCTCAACAGCGGTAAGATCCTTGAGAGTT
TTCGCCCCGAAGAACGTTTTCCAATGATGAGCACTTTTAAAGTTCTGCTATGTG
GCGCGGTATTATCCCGTGTTGACGCCGGGCAAGAGCAACTCGGTCGCCGCATA
CACTATTCTCAGAATGACTTGGTTGAGTACTCACCAGTCACAGAAAAGCATCT
TACGGATGGCATGACAGTAAGAGAATTATGCAGTGCTGCCATAACCATGAGTG
ATAACACTGCGGCCAACTTACTTCTGACAACGATCGGAGGACCGAAGGAGCT
AACCGCTTTTTTGCACAACATGGGGGATCATGTAACTCGCCTTGATCGTTGGG
AACCGGAGCTGAATGAAGCCATACCAAACGACGAGCGTGACACCACGATGCC
TGCAGCAATGGCAACAACGTTGCGCAAACTATTAACTGGCGAACTACTTACTC
TAGCTTCCCGGCAACAATTAATAGACTGGATGGAGGCGGATAAAGTTGCAGGA
CCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTATTGCTGATAAATCTGGA
GCCGGTGAGCGTGGGTCTCGCGGTATCATTGCAGCACTGGGGCCAGATGGTAA
GCCCTCCCGTATCGTAGTTATCTACACGACGGGGAGTCAGGCAACTATGGATG
AACG

TEM-116

CATTTCCGTGTCGCCCTTATTCCCTTTTTTGCGGCATTTTGCCTTCCTGTTTTTG
CTCACCCAGAAACGCTGGTGAAAGTAAAAGATGCTGAAGATCAGTTGGGTGC
ACGAGTGGGTTACATCGAACTGGATCTCAACAGCGGTAAGATCCTTGAGAGTT
TTCGCCCCGAAGAACGTTTTCCAATGATGAGCACTTTTAAAGTTCTGCTATGTG
GCGCGGTATTATCCCGTATTGACGCCGGGCAAGAGCAACTCGGTCGCCGCATA
CACTATTCTCAGAATGACTTGGTTGAGTACTCACCAGTCACAGAAAAGCATCT
TACGGATGGCATGACAGTAAGAGAATTATGCAGTGCTGCCATAACCATGAGTG
ATAACACTGCGGCCAACTTACTTCTGACAACGATCGGAGGACCGAAGGAGCT
AACCGCTTTTTTGCACAACATGGGGGATCATGTAACTCGCCTTGATCGTTGGG
AACCGGAGCTGAATGAAGCCATACCAAACGACGAGCGTGACACCACGATGCC
TGTAGCAATGGCAACAACGTTGCGCAAACTATTAACTGGCGAACTACTTACTC
TAGCTTCCCGGCAACAATTAATAGACTGGATGGAGGCGGATAAAGTTGCAGGA
CCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTATTGCTGATAAATCTGGA

GCCGGTGAGCGTGGGTCTCGCGGTATCATTGCAGCACTGGGGCCAGATGGTAA
GCCCTCCCGTATCGTAGTTATCTACACGACGGGGAGTCAGGCAACTATGGATG
AACG

TEM-181

CATTTCCGTGTCGCCCTTATTCCCTTTTTTGCGGCATTTTGCCTTCCTGTTTTTG
CTCACCCAGAAACGCTGGTGAAAGTAAAAGATGCTGAAGATCAGTTGGGTGC
ACGAGTGGGTTACATCGAACTGGATCTCAACAGCGGTAAGATCCTTGAGAGTT
TTCGCCCCGAAGAACGTTTTCCAATGATGAGCACTTTTAAAGTTCTGCTATGTG
GCGCGGTATTATCCCGTGTTGACGCCGGGCAAGAGCAACTCGGTCGCCGCATA
CACTATTCTCAGAATGACTTGGTTGAGTACTCACCAGTCACAGAAAAGCATCT
TACGGATGGCATGACAGTAAGAGAATTATGCAGTGCTGCCATAACCATGAGTG
ATAACACTGCGGCCAACTTACTTCTGACAACGATCGGAGGACCGAAGGAGCT
AACCGCTTTTTTGCACAACATGGGGGATCATGTAACTCGCCTTGATCGTTGGG
AACCGGAGCTGAATGAAGCCATACCAAACGACGAGCGTGACACCACGATGCC
TGTAGCAATGGCAACAACGTTGCGCAAACTATTAACTGGCGAACTACTTACTC
TAGCTTCCCGGCAACAATTAATAGACTGGATGGAGGCGGATAAAGTTGCAGGA
CCACTTCTGCGCTCGGCCCTTCCGGCTGGCTGGTTTATTGCTGATAAATCTGGA
GCCGGTGAGCGTGGGTCTCGCGGTATCATTGCAGCACTGGGGCCAGATGGTAA
GCCCTCCCGTATCGTAGTTATCTACACGACGGGGAGTCAGGCAACTATGGATG
AACG

Appendix 2

16S rRNA Gene Sequences (5'→3') Used for BLAST Analysis

Strain NRCJ-1

TCGAGCGGATGAAAGGAGCTTGCTCCTGGATTCAGCGGCGGACGGGTGAGTA
ATGCCTAGGAATCTGCCTGGTAGTGGGGGACAACGTTTCGAAAGGAACGCTA
ATACCGCATACGTCCTACGGGAGAAAGCAGGGGACCTTCGGGCCTTGCGCTA
TCAGATGAGCCTAGGTCGGATTAGCTAGTTGGTGAGGTAATGGCTCACCAAG
GCGACGATCCGTAACTGGTCTGAGAGGATGATCAGTCACACTGGAACTGAGA
CACGGTCCAGACTCCTACGGGAGGCAGCAGTGGGGAATATTGGACAATGGGC
GAAAGCCTGATCCAGCCATGCCGCGTGTGTGAAGAAGGTCTTCGGATTGTAA
AGCACTTTAAGTTGGGAGGAAGGGTTGTAGATTAATACTCTGCAATTTTGAC
GTTACCGACAGAATAAGCACCGGCTAACTCTGTGCCAGCAGCCGCGGTAATA
CAGAGGGTGCAAGCGTTAATCGGAATTACTGGGCGTAAAGCGCGCGTAGGTG
GTTTGTTAAGTTGGATGTGAAATCCCCGGGCTCAACCTGGGAACTGCATCCA
AAACTGGCAAGCTAGAGTATGGTAGAGGGTGGTGGAATTTCCTGTGTAGCGG
TGAAATGCGTAGATATAGGAAGGAACACCAGTGGCGAAAGCGACCACCTGC
ACTGATACTGACACTGATGTGCGAAAGCGTGGGGAGCAAACAGGATTAGATA
CCCTGGTAGTCCAGGCCGTAAACTATATCAACTAACCTTTGGGAGCCTTGAAC
TATTATTGGCGCCAGCTCAGCAAATCATTTTACTTCCCGGGGAGGGAAGACC
GCAGGGGGAGGCTTCAAATGTATATTAAAGTGGCCGGGCGCACCCGACGCCC
CTGCAGCTTGTTTCTAAACTACGAGCAAAACCGAAAAACCCCTCGAGGACAG
ACGAACCTAAAGACATTTCCATTAGTGGGTTTGTTGCACTTTGAGAAAAATTC
AAACACAGTCGCACAGTGGACTT

Strain NRCJ-2

AGGCCTAACACATGCAAGTCGAGCGGATGAAAGGAGCTTGCTCCTGGATTCA
GCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGGACAAC
GTTTCGAAAGGAACGCTAATACCGCATACGTCCTACGGGAGAAAGCAGGGG
ACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAGTTGGTG
AGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGATGATCA
GTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGTGG
GGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGTGTGAA
GAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGTTGTAGATT

AATACTCTGCAATTTTGACGTTACCGACAGAATAAGCACCGGCTAACTCTGTG
CCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTACTGGGC
GTAAAGCGCGCGTAGGTGGTTTGTTAAGTTGGATGTGAAATCCCCGGGCTCA
ACCTGGGAACTGCATCCAAAACTGGCAAGCTAGAGTATGGTAGAGGGGGGG
CGGAA

Strain NRCJ-3

GCAGGCCTAACACATGCAAGTCGAGCGGATGAAAGGAGCTTGCTCCTGGATT
CAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGGACA
ACGTTTCGAAAGGAACGCTAATACCGCATACGTCCTACGGGAGAAAGCAGGG
GACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAGTTGGT
GAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGATGATC
AGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGTG
GGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGTGTGA
AGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGTTGTAGAT
TAATACTCTGCAATTTTGACGTTACCGACAGAATAAGCACCGGCTAACTCTGT
GCCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTACTGGG
CGTAAAGCGCGCGTAGGTGGTTTGTTAAGTTGGATGTGAAATCCCCGGGCTC
AACCTGGGAACTGCATCCAAAACTGGCAAGCTAGAGTATGGTAGAGGGTGGT
GGAATTTCCTGTGTAGCGGTGAAATGCCTAGATATAGGAAGGAACACCCTGT
GGCCCAACGCCACCACCTGGACTGATTCTGACACTGCCGTGCCAAAGCGTGG
GTAGCAATCAGGCTTAGATCCCCCGGGCTGCTACCCCCTCCATCCAACCCAA
CTACCG

Strain NRCJ-4

TCGAACGGCAGCACAGTAAGAGCTTGCTCTTATGGGTGGCGAGTGGCGGACG
GGTGAGGAATACATCGGAATCTACCTTTTCGTGGGGGATAACGTAGGGAAAC
TTACGCTAATACCGCATACGACCTTCGGGTGAAAGCAGGGGACCTTCGGGCC
TTGCGCGGATAGATGAGCCGATGTCGGATTAGCTAGTTGGCGGGGTAAAGGC
CCACCAAGGCGACGATCCGTAGCTGGTCTGAGAGGATGATCAGCCACACTGG
AACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGTGGGGAATATTGG
ACAATGGGCGCAAGCCTGATCCAGCCATACCGCGTGGGTGAAGAAGGCCTTC
GGGTTGTAAAGCCCTTTTGTTGGGAAAGAAAAGCAGTCGGCTAATACCCGGT
TGTTCTGACGGTACCCAAAGAATAAGCACCGGCTAACTTCGTGCCAGCAGCC

GCGGTAATACGAAGGGTGCAAGCGTTACTCGGAATTACTGGGCGTAAAGCGT
GCGTAGGTGGTTGTTTAAGTCTGTTGTGAAAGCCCTGGGCTCAACCTGGGAAT
TGCAGTGGATACTGGGCGACTAGAGTGTGGTAGAGGGTAGTGGAATTCCCGG
TGTAGCAGTGAAATGCGTAGAGATCGGGAGGAACATCCATGGCGAAAGGCA
GCTACCTGGACCAACACTGACACTGAGGCACGAAAGCGTGGGGAGCAAACA
GGATTAGATACCCTGGTAGTCCACGCCCTAAAACGATGCGAACTGGATGTTG
GGTGCAATTTGGCACGCA

Strain NRCJ-5

TACACCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGTGCAAC
CCACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCAC
CGCGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCGAGTT
GCAGACTGCGATCCGGACTACGATCGGTTTTATGGGATTAGCTCCACCTCGCG
GCTTGGCAACCCTTTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGTA
AGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGCA
GTCTCCTTAGAGTGCCCACCATAACGTGCTGGTAACTAAGGACAAGGGTTGC
GCTCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCCA
TGCAGCACCTGTCTCAATGTTCCCGAAGGCACCAATCCATCTCTGGAAAGTTC
ATTGGATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTAAACCACA
TGCTCCACCGCTTGTGCGGGCCCCCGTCAATTCATTTGAGTTTTAACCTTGCG
GCCGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAGAGCT
CAAGGCTCCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACCAGGGTA
TCTAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATCAGTCCA
GGTGGTCGCCTTCGCCACTGGTGTTCCTTCCTATATCTACGCATTTCACCGCTA
CACAGGAAATTCCACCACCCTCTACCATACTCTAGCTTGCCAGTTTTGGATGC
AGTTCCCAGGTTGAGCCCGGGGATTTCACATCCAACTTAACAAACCACCTAC
GCGCGCTTTACGCCCAGTAATTCCCGATTAACGCTTGCACCCTCTGTATTACC
GCGGCTGCTGGCACAGAGTTAGCCCG

Strain NRCJ-6

TGCTTAAACATGCAAGTCGAGCGGAAAGGCTCCTTCGGGGGTACTCGAGCGG
CGAACGGGTGAGTAACACGTGAGTAATCTGCCCTGTGCTCTGGGATAGCCAC
CGGAAACGGTGATTAATACCGGATATGACTGCTACCCGCATGGGTTGGTGGT
GGAAAGTTTTTCGGCGCAGGATGTGCTCGCGGCCTATCAGCTTGTTGGTGAG

GTAATGGCTCACCAAGGCTTTGACGGGTAGCCGGCCTGAGAGGGTGACCGGT
CACACTGGGACTGAGACACGGCCCAGACTCCTACGGGAGGCAGCAGTGGGG
AATATTGGACAATGGGCGGAAGCCTGATCCAGCAACGCCGCGTGAGGGATG
ACGGCCTTCGGGTTGTAAACCTCTTTCAGTACCGACGAAGCGAAAGTGACGG
TAGGTACAGAAGAAGGACCGGCCAACTACGTGCCAGCAGCCGCGGTAATAC
GTAGGGTCCGAGCGTTGTCCGGAATTATTGGGCGTAAAGGGCTCGTAGGCGG
TTTGTCGCGTCGGGAGTGAAAACAGCCAGCTTAACTGGTTGCTTGCTTTCGAT
ACGGGCAGACTAGAGGTATGCAGGGGAGAATGGAATTCCTGGTGTAGCGGT
GAAAATGCGCAGATATCAGGAGGAACACCGGTGGCGAAGGCGGTTCTCTGG
GCATTACCTGACGCTGAGGAGCGAAAGTGTGGGGGAGCGAACAAGATTATAT
ACCCTGGTAGTCCACACCGTAAACGTTGGGCGCTAGGTGTGGGGACCAAATC
CATTGGGTTCCGTGCCGTACTAACACAAATAACCACCCCCCCTGGGGAGTG
CAGCGGCGGGGCTAAAACTAAAAGAATAGCAGGGGAC

Strain NRCJ-7

CACCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGTGCAACCC
ACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCACCG
CGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCGAGTTGC
AGACTGCGATCCGGACTACGATCGGTTTTATGGGATTAGCTCCACCTCGCGGC
TTGGCAACCCTTTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGTAAG
GGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGCAGT
CTCCTTAGAGTGCCCACCATAACGTGCTGGTAACTAAGGACAAGGGTTGCGC
TCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCCATG
CAGCACCTGTCTCAATGTTCCCGAAGGCACCAATCCATCTCTGGAAAGTTCAT
TGGATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTAAACCACATG
CTCCACCGCTTGTGCGGGCCCCCGTCAATTCATTTGAGTTTTAACCTTGCGGC
CGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAGAGCTCA
AGGCTCCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACCAGGGTATC
TAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATCAGTCCAGG
TGGTCGCCTTCGCCACTGGTGTTCCTTCCTATATCTACGCATTTCACCGCTACA
CAGGAAATTCCACCACCCTCTACCATACTCTAGCTTGCCAGTTTTGGGATGCA
GTTCCCAGGTTGAGCCCGGGATTTCACATCCAACTTAACAAACCACCTACGC
GCGCTTTACGCCCAGTAATTCCGATTAACGCTTGCACCCTCTTGTATTACCG

Strain NRCJ-8

GCAGGCCTAACACATGCAAGTCGAGCGGCAGCACGGGTACTTGTACCTGGTG
GCGAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGG
ATAACGCTCGGAAACGGACGCTAATACCGCATACGTCCTACGGGAGAAAGC
AGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAG
TTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGA
TGATCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGC
AGTGGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGT
GTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGCATT
TACCTAATACGTAAGTGTTTTGACGTTACCGACAGAATAAGCACCGGCTAAC
TCTGTGCCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTA
CTGGGCGTAAAGCGCGCGTAGGTGGTTCGTTAAGTTGGATGTGAAATCCCCG
GGCTCAACCTGGGAACTGCATTCAAAACTGTCGAGCTAGAGTATGGTAGAGG
GTGGTGGGAATTTTCCTGGGTTCCCAGGGGGAAATTCTTCATCTTGAAAGGG
GAAAACCTTTGAGGGAAGTCAAACCCGGGTCCCGACCCGCGCCTTCCCACCG
CCAAAGCCAGGTGAACCCCAAGTGGTTCACATCCCCTGTTGGTCTCCACTCCC
AAATCTACCCATTACCCCGGTGCGAACGTAAAAACCCAAATCGCCTCATATA
ATGCATGAGATCATCTTCGGGGGGAGTCCCCAAGGAGGCAAAGCTTATATCA
TTTGATGGGGCCCCCAACCGCGGCGGACCTGGGGCATAATTTCGAAGCACCC
CGAAGACCCCCCTGAGTCTCGGCCGCCCAGCGGACCTACAAGAAGTGGGATT
GTTGCCTTGGGGGAAACTTAAAAACAAGGTTGCAGGAATGGAGGAACAAAC
CCCCCTCCGTTCCCCAGGTAAGTAGGGGGTTAAGTTCCCCAAAAAAAAACGCT
GCAACCCCAATCTCCCCTTCAGATTG

Strain NRCJ-9

ATCACCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGTGCAAC
CCACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCAC
CGCGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCGAGTT
GCAGACTGCGATCCGGACTACGATCGGTTTTATGGGATTAGCTCCACCTCGCG
GCTTGGCAACCCTCTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGT
AAGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGC
AGTCTCCTTAGAGTGCCCACCATTACGTGCTGGTAACTAAGGACAAGGGTTG
CGCTCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCC
ATGCAGCACCTGTCTCAATGTTCCCGAAGGCACCAATCCATCTCTGGAAAGTT

CATTGGATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTAAACCAC
ATGCTCCACCGCTTGTGCGGGCCCCCGTCAATTCATTTGAGTTTTAACCTTGC
GGCCGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAGAGC
TCAAGGCTCCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACCAGGGT
ATCTAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATCAGTCC
AGGTGGTCGCCTTCGCCACTGGTGTTCCTTCCTATATCTACGCATTTCACCGCT
ACACAGGAAATTCCACCACCCTCTACCATACTCTAGCTTGTCAGTTTTGAATG
CAGTTCCCAGGTTGAGCCCGGGGCTTTCACATCCAACTTAACAAACCACCTA
CGCGCGCTTTACGCCCAGTAATTCCGATTAACGCTTGCACCCTCT

Strain NRCJ-10

CCGCACACCGTGGCAAGCGCCCTCCCGAAGGTTAAGCTACCTGCTTCTGGTG
CAACAAACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTAT
TCACCGCAGCAATGCTGATCTGCGATTACTAGCGATTCCGACTTCATGGAGTC
GAGTTGCAGACTCCAATCCGGACTGAGATAGGGTTTCTGGGATTGGCTTGCC
CTCGCGGGTTTGCAGCCCTCTGTCCCTACCATTGTAGTACGTGTGTAGCCCTG
GTCGTAAGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCA
CCGGCGGTCTCCTTAGAGTTCCCACCATTACGTGCTGGCAACTAAGGACAAG
GGTTGCGCTCGTTGCGGGACTTAACCCAACATCTCACGACACGAGCTGACGA
CAGCCATGCAGCACCTGTGTTCGAGTTCCCGAAGGCACCAATCCATCTCTGG
AAAGTTCTCGACATGTCAAGACCAGGTAAGGTTCTTCGCGTTGCATCGAATTA
AACCACATACTCCACCGCTTGTGCGGGCCCCCGTCAATTCCTTTGAGTTTCAG
TCTTGCGACCGTACTCCCCAGGCGGCGAACTTAACGCGTTAGCTTCGATACTG
CGTGCCAAATTGCACCCAACATCCAGTTCGCATCGTTTAGGGCGTGGACTAC
CAGGGTATCTAATCCTGTTTGCTCCCCACGCTTTCGTGCCTCAGTGTCAGTGTT
GGTCCAGGTAGCTGCCTTCGCCATGGATGTTCCTCCCGATCTCTACGCATTTC
ACTGCTACACCGGGAATTCCACTACCCTCTACCACACTCTAGTCGCCCAGTAT
CCACTGCAATTCCCAGGTTGAGCCCAGGGCTTTCACAACAGACTTAAACAAC
CACCTACGCACGCTTTACGCCCAGTAATTCCGAGTAACGCTTGCACCCTTCGT
ATTACCGCGGCTGCTGGCACGAAGTTAGCCC

Strain NRCJ-11

CTGCGGCGTGCTTAACACATGCAAGTCGAACGATGATGCCCAGCTTGCTGGG
TGGATTAGTGGCGAACGGGTGAGTAACACGTGAGTAACCTGCCCCTGACTCT

GGGATAAGCGTTGGAAACGACGTCTAATACTGGATATGATCGCCGGCCGCAT
GGTCTGGTGGTGGAAAGATTTTTTGGTTGGGGATGGACTCGCGGCCTATCAG
CTTGTTGGTGAGGTAATGGCTCACCAAGGCGACGACGGGTAGCCGGCCTGAG
AGGGTGACCGGCCACACTGGGACTGAGACACGGCCCAGACTCCTACGGGAG
GCAGCAGTGGGGAATATTGCACAATGGGCGAAAGCCTGATGCAGCAACGCC
GCGTGAGGGATGACGGCCTTCGGGTTGTAAACCTCTTTTAGTAGGGAAGAAG
CGAAAGTGACGGTACCTGCAGAAAAAGCACCGGCTAACTACGTGCCAGCAG
CCGCGGTAATACGTAGGGTGCAAGCGTTGTCCGGAATTATTGGGCGTAAAGA
GCTCGTAGGCGGTTTGTCGCGTCTGCTGTGAAATCCCCAGGCTCAACATCTCG
CTTGCAGTGGGTACGCGCGGACTATAGTGCGGCGGGGGGAGATTATTGGAAT
TTCCTGGAGGAA

Strain NRCJ-12

CGGAACCTGCGCGTGCTTAAACATGCAAGTCGAACGATGATGCCCAGCTTGC
TGGGTGGATTAGTGGCGAACGGGTGAGTAACACGTGAGTAACCTGCCCCTGA
CTCTGGGATAAGCGTTGGAAACGACGTCTAATACTGGATATGATCACCGGCC
GCATGGTCTGGTGGTGGAAAGATTTTTTGGTTGGGGATGGACTCGCGGCCTAT
CAGCTTGTTGGTGAGGTAATGGCTCACCAAGGCGACGACGGGTAGCCGGCCT
GAGAGGGTGACCGGCCACACTGGGACTGACACACGGCCCAGACTCCTACGG
GAGGCAGCAGTGGGGAATATTGCACAATGGGCGAAAGCCTGATGCAGCAAC
GCCGCGTGAGGGATGACGGCCTTCGGGTTGTAAACCTCTTTTAGTAGGGAAG
AAGCGAAAGTGACGGTACCTGCAGAAAAAGCACCGGCTAACTACGTGCCAG
CAGCCGCGGTAATACGTAGGGTGCAAGCGTTGTCCGGAATTATTGGGCGTAA
AGAGCTCGTAGGCGGTTTGTCGCGTCTGCTGTGAAATCCCGAGGCTCAACCTC
GGGCTTGCAGTGGGTACGGGCAGACTAGAGTGCGGTAGGGGAGATTGGAATT
CCTGGTGTAGCGGTGGAATGCGCAGATATCATGAGGAACACCGATGGCGAAG
GCAGATCTCTGGGCCGTAACTGACGCTGAGGAGCGAAAGCGTGGGGAGCGA
ACAGGATTAGATACCCTGGTAGTCCACGCCGTAAACGTTGGGCGCTAGATGT
AGGGACCTTTCCACGGTTTCTGTGTCGTAGCTAACGCATTAAGCGCCCCGCCT
GGGAGTACGCCGCAAGGCTAAACTCAAAGGAATGACGGGGCCCGCACAACG
GCGGAGCATGCGATTAATTCGATGCAACGCGAAGAACCTTACAAAGCTTGAC
ATACACCCGAAACGCTAGAGATGGTCGCCCCCTGTGTCGGGTACAGGTGTGC
ATGGTGTCGTCACTCTGCCTGGATGTAGGTTAAGTCCACACAGCCAACGCTCG
TTCATATTGCCAGCCCTTAGCAGGACTCATAGAAACTACAGGTCACTCGGAG
AAGTGGGATGAGTGAAACACGACCACTAGCTGGTCTTAGCAGCTACCATGCC

GTCAAGGGTCGCGTAACCGTAGTAAGCGATAGCGAGAGAACCAGTCAATCG
ATAGAGTTCTGGACACTATCACTCATAGCTACACCTG

Strain NRCJ-13

AGAGAGCTTGCTCTCTGATTCAGCGGCGGACGGGTGAGTAATGCCTAGGAAT
CTGCCTGGTAGTGGGGGACAACGTCTCGAAAGGGACGCTAATACCGCATACG
TCCTACGGGAGAAAGCAGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCT
AGGTCGGATTAGCTAGTTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGT
AACTGGTCTGAGAGGATGATCAGTCACACTGGAACTGAGACACGGTCCAGAC
TCCTACGGGAGGCAGCAGTGGGGAATATTGGACAATGGGCGAAAGCCTGATC
CAGCCATGCCGCGTGTGTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGT
TGGGAGGAAGGGTTGTAGATTAATACTCTGCAATTTTGACGTTACCGACAGA
ATAAGCACCGGCTAACTCTGTGCCAGCAGCCGCGGTAATACAGAGGGTGCAA
GCGTTAATCGGAATTACTGGGCGTAAAGCGCGCGTAGGTGGTTTGTTAAGTT
GGATGTGAAAGCCCCGGGCTCAACCTGGGAACTGCATTCAAAACTGACAAGC
TAGAGTATGGTAGAGGGTGGTGGAATTTCCTGTGTAGCGGTGAAAATGCGTA
GATATAGGAAGGGACACCAGTGGCGAAGGCGACCACCTGGGCTGATACTGA
CACTGAGGTGCGAAACGTGGGGGAGCAAACACGAGTAGATACCCTGGTAGT
CGACGCCGCATACGATGTCAACTAGCCGTTGGGGGCCTTGAGCTCTTATTGGC
GCCCTCACCACATTAATTTGATAGCCTGTGGGGAGCGGCCGGCCGGGTGGAA
CACACACGTATTAATTGCGGCGCGCACAACACTGGGGCGAGTCAGTGTTATT
TAATGCAACGCACGAACAAGAACCAGACTGGCCTC

Strain NRCJ-14

TACGATACACCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGT
GCAACCCACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTA
TTCACCGCGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTC
GAGTTGCAGACTGCGATCCGGACTACGATCGGTTTTCTGGGATTAGCTCCACC
TCGCGGCTTGGCAACCCTCTGTACCGACCATTGTAGCACGTGTGTAGCCCAG
GCCGTAAGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCA
CCGGCAGTCTCCTTAGAGTGCCCACCATTACGTGCTGGTAACTAAGGACAAG
GGTTGCGCTCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGA
CAGCCATGCAGCACCTGTCTCAATGTTCCCGAAGGCACCAATCCATCTCTGG
AAAGTTCATTGGATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTA

AACCACATGCTCCACCGCTTGTGCGGGCCCCCGTCAATTCATTTGAGTTTTAA
CCTTGCGGCCGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTA
AGAGCTCAAGGCTCCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACC
AGGGTATCTAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATC
AGTCCCAGGTGGTCGCCTTCGCCACTGGTGTTCCTTCCTATATCTACGCATTTC
ACCGCTACACAGGAAATTCCACCACCCTCTACCATACTCTAGCTCGACAGTTT
TGAATGCAGTTCCCAGTTGAGCCCGGGGATTTCACATCCAACTTAACGAACC
ACCTACGCGCGCTTTACGCCCAGTAATTCCGATTAACGCTTGCACCCTCTGTA
TTACCGCGGCTGCTGGCAC

Strain NRCJ-15

TCACCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGTGCAACC
CACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCACC
GCGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCGAGTTG
CAGACTGCGATCCGGACTACGATCGGTTTTCTGGGATTAGCTCCACCTCGCGG
CTTGGCAACCCTCTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGTA
AGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGCA
GTCTCCTTAGAGTGCCCACCATTACGTGCTGGTAACTAAGGACAAGGGTTGC
GCTCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCCA
TGCAGCACCTGTCTCAATGTTCCCGAAGGCACCAATCCATCTCTGGAAAGTTC
ATTGGATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTAAACCACA
TGCTCCACCGCTTGTGCGGGCCCCCGTCAATTCATTTGAGTTTTAACCTTGCG
GCCGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAGAGCT
CAAGGCTCCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACCAGGGTA
TCTAATCCTGTTTGCTCCCCACGCTTTTCGCACCTCAGTGTCAGTATCAGTCCA
GGTGGTCGCCTTCGCCACTGGTGTTCCTTTCCTATATCTACGCATTTTACCGCT
ACACAGGATAATTTCCACCCACCCTCTACCCATACTCTAGCTCGACAGTTTTG
AATGCAGGTTCCCAGGTTGAGCCCGGGGATTTCACATCCTACTTAACGAACC
ACCCTACGCGCGCCTTTACGCCCAGTAATTTCTGATTTAACGCTTGCACCCTC
CTGTATTACCGCTGCTTGCCTGGCACAGAGGTTAGTCCGGTGCTTATTTTCTG
TTCGCTACCGGCAAAAACATCTTACGTTTTTAGGTAAAATGCCTCTTCCCTTC
CCTCACTTAAAACAGGTCTTACACTTCCGTAAGAACCTTTTCTTCACAACACT
GCCGACATACTGG

Strain NRCJ-16

AGAGCTTGCTCTCTGATTCAGCGGCGGACGGGTGAGTAATGCCTAGGAATCT
GCCTGGTAGTGGGGGACAACGTCTCGAAAGGGACGCTAATACCGCATACGTC
CTACGGGAGAAAGCAGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAG
GTCGGATTAGCTAGTTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAA
CTGGTCTGAGAGGATGATCAGTCACACTGGAACTGAGACACGGTCCAGACTC
CTACGGGAGGCAGCAGTGGGGAATATTGGACAATGGGCGAAAGCCTGATCC
AGCCATGCCGCGTGTGTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTT
GGGAGGAAGGGTTGTAGATTAATACTCTGCAATTTTGACGTTACCGACAGAA
TAAGCACCGGCTAACTCTGTGCCAGCAGCCGCGGTAATACAGAGGGTGCAAG
CGTTAATCGGAATTACTGGGCGTAAAGCGCGCGTAGGTGGTTTGTTAAGTTG
GATGTGAAAGCCCCGGGCTCAACCTGGGAACTGCATTCAAAACTGACAAGCT
AGAGTATGGTAGAGGGTGGTGGAATTTCCTGTGTAGCGGTGAAATGCGTAG
ATATAGGAAGGAACACCAGTGGCCGAAAGCGACCACCCTGGGACTGATACT
GACACTGAGGTGCGAAAGCGTGGGGAGCACACAGCGATTAGATACCCCTG
GGAGTCCCACGCCGCCAACGACGTCAACTAGCCGTCTGGAAGCCTCGAGCTA
CTACTGGCGCAACCTAACGCA

Strain NRCJ-17

TGGATTTGAGAGCTTGCTCTCAAGAAGTTAGCGGCGGACGGGTGAGTAACAC
GTGGGTAACCTGCCCATAAGACTGGGATAACTCCGGGAAACCGGGGCTAATA
CCGGATAACATTTTGAACTGCATGGTTCGAAATTGAAAGGCGGCTTCGGCTG
TCACTTATGGATGGACCCGCGTCGCATTAGCTAGTTGGTGAGGTAACGGCTC
ACCAAGGCAACGATGCGTAGCCGACCTGAGAGGGTGATCGGCCACACTGGG
ACTGAGACACGGCCCAGACTCCTACGGGAGGCAGCAGTAGGGAATCTTCCGC
AATGGACGAAAGTCTGACGGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGG
GTCGTAAAACTCTGTTGTTAGGGAAGAACAAGTGCTAGTTGAATAAGCTGGC
ACCTTGACGGTACCTAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCG
CGGTAATACGTAGGTGGCAAGCGTTATCCGGAATTATTGGGCGTAAAGCGCG
CGCAGGTGGTTTCTTAAGTCTGATGTGAAAGCCCACGGCTCAACCGTGGAGG
GTCATTGGAAACTGGGAGACTTGAGTGCAGAAGAGGAAAGTGGAATTCCATG
TGTAGCGGTGAAATGCGTAGAGATATGGAGGAACACCAGTGGCGAAGGCGA
CTTTCTGGTCTGTAACTGACACTGAGGCGCGAAAGCGTGGGGAGCAAACAGG
ATTAGATACCCTGGTAGTCCACGCCGTAAACGATGAGTGCTAAGTGTTAGAG

GGTTTCCGCCCTTTAGTGCTGAAGTTAACGCATTAAGCACTCCGCCTGGGGAG
TACGGCCGCAAGGCTGAAACTCAAAGGAATTGACGGGGCCCGCACAAGCGG
TGGAGCATGTGGTTTAATTCGAAGCAACGCGAAGAACCTTACCAGGTCGTGA
CATCCTCTGAAAACCCTAGAGATAGGGCTTCTCCTTCCGGAGCAGAGTGACA
GGAGGTGCATGGTTGTCGTCAGCTCTGTC

Strain NRCJ-18

TGACTGAGAGGCCTAAACATGCAAGTCGGCGGCTGAAGAGAGCCTGGTCTCT
GATTCCCGCGGAGGGTGAGTGTGCCTCTAAATCTGCCTGGTGTTGTGGGACA
ACATCTCGAAAGGGACGCTCATATACCATACGTCCTATAGGAGAAAGCGCGG
GACCTTCTGGCCTTGTGCTATCTCATGAGCCTAGGTCGGATTTTATAGTTGGT
GAGGTAATGGCTCACCAAGGCGACAATCCGTAACTGGTCTGAGAGGATGATC
TCTCACACTGGAACTGAGACACGGTCCCCACTCCTACGGGAGGCACCACTGG
GGAATATTGTACACTGGGCGAAAGCCTGATCCAGCCCTGCCCCGTGTGTGAA
AAAAGTCTTCTGATTGTAAAGCACTTTAAGTTGGGAGGAAAGGGTGTTTATT
AATACTCTTCAGTTTTGACGTTACCCACACAATAAGCACCCGCTAACTCTGTG
CCAGCACCCCCGGTAATACACAGGGTGCACGCGTTAATCTCAATTACTCGGC
GTATAGCGCGCGTATGTGTTGTGTTAAGTTGGATGTGAAAACTCCGGGCTCA
AACTGTGAACTGTGCTCTCAACTGTGTAGCTCTAGTGTGTTATAGAGTGTGGT
GATTTTTCTGTGTGTCGCTGAGATGCGTATATATATGAGGGAGCACCCCTGTC
GAAAGCGCCCCCATGTACTGATGACTCTCACTCTGGTGCGCGAGCGCGTGGA
GCAACACACGAGTATGATATACTCTTAGTACTCCGACGCCATACGATGATGA
ACAACTACGCTGGTGAGCCCTCTTGCTCTTATTAGGCGGCCGCTCTCACAGTT
ATTATTGTTCCCCCTCGTGAGTAGCTAGCCCGCCCCGATGTATACTACTCATG
ATTATGTTCGAGCGGGCCGCGCCGCACACCGCATGAGCATGATGGTGTTATTT
CTAGCACAGCGCGAAGCACTTACCGACGCTGTCATCCACTAGCATTCTCCAA
AGAGTAGTGGTCGCTTTGCAGCAGTTGACCAGGCAGCATGAGCGATTGCTAC
ACTAGGCTGCATTGCGTATGTGCCTACACGGCACTTCC

Strain NRCJ-19

TCGAGCGGCAGCACGGGTACTTGTACCTGGTGGCGAGCGGCGGACGGGTGAG
TAATGCCTAGGAATCTGCCTGGTAGTGGGGGATAACGCTCGGAAACGGACGC
TAATACCGCATACGTCCTACGGGAGAAAGCAGGGGACCTTCGGGCCTTGCGC
TATCAGATGAGCCTAGGTCGGATTAGCTAGTTGGTGAGGTAATGGCTCACCA

AGGCGACGATCCGTAACTGGTCTGAGAGGATGATCAGTCACACTGGAACTGA
GACACGGTCCAGACTCCTACGGGAGGCAGCAGTGGGGAATATTGGACAATG
GGCGAAAGCCTGATCCAGCCATGCCGCGTGTGTGAAGAAGGTCTTCGGATTG
TAAAGCACTTTAAGTTGGGAGGAAGGGCATTTACCTAATACGTAAGTGTTTT
GACGTTTCCGACAGAATAAGCACCGGCTAACTCTGTGCCAACAGCCGCGGTA
AAGAAAAGGGAGGTACGTAAAATGGAAAAAAAGGGGGCAAAAGCCCCGGA
AGGTGGTCCCGTAAATTGAGATGTTAAAATCCGTGGGAACAAAG

Strain NRCJ-20

CCGTGGCAGCGCCCTCCCGAAGGTTAAGCTACCTGCTTCTGGTGCAACAAAC
TCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCACCGCA
GCAATGCTGATCTGCGATTACTAGCGATTCCGACTTCATGGAGTCGAGTTGCA
GACTCCAATCCGGACTGAGATAGGGTTTCTGGGATTGGCTTACCGTCGCCGG
CTTGCAGCCCTCTGTCCCTACCATTGTAGTACGTGTGTAGCCCTGGCCGTAAG
GGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGCGGT
CTCCTTAGAGTTCCCACCATTACGTGCTGGCAACTAAGGACAAGGGTTGCGCT
CGTTGCGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCCATGC
AGCACCTGTGTTCGAGTTCCCGAAGGCACCAATCCATCTCTGGAAAGTTCTCG
ACATGTCAAGGCCAGGTAAGGTTCTTCGCGTTGCATCGAATTAAACCACATA
CTCCACCGCTTGTGCGGGCCCCCGTCAATTCCTTTGAGTTTCAGTCTTGCGAC
CGTACTCCCCAGGCGGCGAACTTAACGCGTTAGCTTCGATACTGCGTGCCAA
ATTGCACCCAACATCCAGTTCGCATCGTTTAGGGCGTGGACTACCAGGGTATC
TAATCCTGTTTGCTCCCCACGCTTTCGTGCCTCAGTGTCAGTGTTGGTCCAGGT
AGCTGCCTTCGCCATGGATGTTCCTCCTGATCTCTACGCATTTCACTGCTACA
CCAGGAATTCCGCTACCCTCTACCACACTCTAGTCGTCCAGTTTCCACTGCAG
TTCCCAGGTTGAGCCCAGGGCTTTCACAACAGACTTAAACGACCACCTACGC
ACGCTTTACGCCCAGTAATTCCGAGTAACGCTTGCACCCTTCGTATTACCGCG
GCTGCTGGCACGAAGTTAGCCGGTGCTTATTTCTTTGGGTACCGTCATCCCAA
CCGG

Strain NRCJ-21

TACACCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGTGCAAC
CCACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCAC
CGCGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCGAGTT

GCAGACTGCGATCCGGACTACGATCGGTTTTGTGAGATTAGCTCCACCTCGCG
GCTTGGCAACCCTCTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGT
AAGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGC
AGTCTCCTTAGAGTGCCCACCATAACGTGCTGGTAACTAAGGACAAGGGTTG
CGCTCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCC
ATGCAGCACCTGTGTCAGAGTTCCCGAAGGCACCAATCCATCTCTGGAAAGT
TCTCTGCATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTAAACCA
CATGCTCCACCGCTTGTGCGGGCCCCCGTCAATTCATTTGAGTTTTAACCTTG
CGGCCGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAAAT
CTCAAGGATTCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACCAGGG
TATCTAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATCAGTCC
AGGTGGTCGCCTTCGCCACTGGTGTTCCTTCCTATATCTACGCATTTCACCGCT
ACACAGGAAATTCCACCACCCCTCTACCGTACTCTAGCTTGCCAGTTTTGGGA
TGCAGTTCCCAGGTTGAGCCCGGGGCTTTCACATCCAACTTAACAAACCACCT
ACGCGCGCTTTACGCCCAGTAATTCCGATTAACGCTTGCACCTCTGTATTACC
GCGGCTGCTGGCACAGAGTTAGCC

Strain NRCJ-22

GTAGGCTCTACACATGCAAGTCGAACGGCAGCACAGGTAAGAACCTTGCTCT
TATGGGTGGCGAGTGGCGATCGGGTGATGAATACATAATAACTCTACGGTTA
ACTTGGGGGAAACGTAATGGAAACTTACTTTAAAATTTCAAGATAACTAAAA
TGCGATGGCATTTTATGGTGGGGAAATGTTCGATTGAATGAGCCGATGTCGG
ATTAGCTAGTTGGCGGGGTAAAGGCCCACCAAGGCGACGATCCGTAGCTGGT
CTGAGAGGATGATCAGCCACACTGGAACTGAGACACGGTCCAGACTCCTACG
GGAGGCAGCAGTGGGGAATATTGGACAATGGGCGCAAGCCTGATCCAGCCA
TACCGCGTGGGGGAAGAAAGGCTGGCCGTTGTGTAACACTTTTTTTTGGGAG
GAAAAGACACGATGCAACACCTGGTGTGAGAGTTCGCAAAAGAACCAATCA
ACCTCGGGGGAAGTTCTCTACATGTCTAGGGGGGGTAAAATTGTTCGCGCTTC
AACTAAAAAAAACAGATACTCAAGCGCGGGTGCGCGCCCCCGAAACTTACTT
TGAGAACACTCTTGTGACCGTCCTCCCCGGGCGGGGAAACTGAAAGCGTTTA
CTGTGCTACAGCGTGCAAAATCCCCCCCGCATCTAATACACATCTTGTAGGG
GGGTGGATACAAGGTTATCAATTCGTGTTTGCTCCCCACACTTTGTCGCCACA
GAGTGAGAGTTTGTGAGGAAACAGCCCTCGAGACGGTGGTTGTCTCACCACT
CGAGAGTTTAACTGCGCGGCGGGGGGATATTTCGCTCTCATTCAACACTAAA

CCTTTCTATTTCGCTGCACGCGCGAGTGTTCGCCCGGGCCTCCACACACAAAT
ATAA

Strain NRCJ-23

TCGAGCGGATGAAGAGAGCTTGCTCTCTGATTCAGCGGCGGACGGGTGAGTA
ATGCCTAGGAATCTGCCTGGTAGTGGGGGACAACGTTTCGAAAGGAACGCTA
ATACCGCATACGTCCTACGGGAGAAAGCAGGGGACCTTCGGGCCTTGCGCTA
TCAGATGAGCCTAGGTCGGATTAGCTAGTTGGTGAGGTAATGGCTCACCAAG
GCGACGATCCGTAACTGGTCTGAGAGGATGATCAGTCACACTGGAACTGAGA
CACGGTCCAGACTCCTACGGGAGGCAGCAGTGGGGAATATTGGACAATGGGC
GAAAGCCTGATCCAGCCATGCCGCGTGTGTGAAGAAGGTCTTCGGATTGTAA
AGCACTTTAAGTTGGGAGGAAGGGTTGTAGATTAATACTCTGCAATTTTGAC
GTTACCGACAGAATAAGCACCGGCTAACTCTGTGCCAGCAGCCGCGGTAATA
CAGAGGGTGCAAGCGTTAATCGGAATTACTGGGCGTAAAGCGCGCGTAGGTG
GTTTGTTAAGTTGGATGTGAAAGCCCCGGGCTCAACCTGGGAACTGCATTCA
CAACTGAGAAGCTCTAGTATGGTAGAGGGTGCTGGAAAAATCTCAAGGTTCC
CGGGGGCTAGCTTAACATCTATTTACGGACTGCATTCCCCGGGTGCCACAATC
CGGTTTGCACACCACGCTTTGGGGCCCAAAGGGGGGGGGGACACTACAGGG
ATATCATACCGGGGAAGGGGAGAATCCTTTACAACAATGTCAAATATTGCCT
GGGACCCATTTAAAGTTTCTACCCCGGCTCTCCAAGCGCTTTAATTTTGACGT
ACAAGAGAACAAGTGCCGCGGTTGGGTCAAGTGGCCTATAAAATAGACAGG
ACCCCCCGACACACCCCCGCCCGCACCCTTGTTAGATATAATGTGGGGACAT
CTGCGGAGAGAACCACACCAAGGGGAGGAGAACAAACGAAGCACCCCTTCC
CCCGAAATATGGGTGGTGGTTTTTATTTTCGGGAGAACATACACACACCACG
CCTGCCCAGCCATGGGCATGA

Strain NRCJ-24

TGCAAGCTCGAGCGGATGAAGAAGAAGCTCTGCTCTCTGATTCAGCGGCGGA
CGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGGACAACGTCTCGAA
AGGGACGCTAATACCGCATACGTCCTACGGGAGAAAGCAGGGGACCTTCGG
GCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAGTTGGTGAGGTAAT
GGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGATGATCAGTCACAC
TGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGTGGGGAATATT
GGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGTGTGAAGAAGGTCT

TCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGTTGTAGATTAATACTCT
GCAATTTTGACGTTACCGACAGAATAAGCACCGGCTAACTCTGTGCCAGCAG
CCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTACTGGGCGTAAAGC
GCGCGTAGGTGGTTTGTTAAGTTGGATGTGAAAGCCCCGGGCTCAACCTGGG
AACTGCATTCAAAACTGACAAGCTAGAGTATGGTAGAGGGTGGTGGAATTTC
CTGTGTAGCGGTGAAATGCGTAGATATAGGAAGGAACACCAGTGGCGAAGG
CGACCACCTGGACTGATACTGACACTGAGGTGCGAAAGCGTGGGGAGCAAA
CAGGATTAGATACCCTGGTAGTCCACGCCGTAAACGATGTCAACTAGCCGTT
GGGAGCCTTGAGCTCTTAGTGGCGCAGCTAACGCATTAAGTTGACCGCCTGG
GGAGTACGGCCGCAAGGTTAAAACTCAAATGAATTGACGGGGCCCGCACAA
GCGGTGGAGCATGTGGTTTAATTCGAAGCAACGGCGAAGAACCTTACCAGGC
CCTTGACATCCAATGAACTTTCCAGAGATGGATTGGTGCCTTCG

Strain NRCJ-25

ACATGCAAGTCGAGCGGCAGCACGGGTACTTGTACCTGGTGGCGAGCGGCGG
ACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGGATAACGCTCGGA
AACGGACGCTAATACCGCATACGTCCTACGGGAGAAAGCAGGGGACCTTCG
GGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAGTTGGTGAGGTAA
TGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGATGATCAGTCACA
CTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGTGGGGAATAT
TGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGTGTGAAGAAGGTC
TTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGCATTTACCTAATACGT
AAGTGTTTTGACGTTACCGACAGAATAAGCACCGGCTAACTCTGTGCCAGCA
GCCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTACTGGGCGTAAAG
CGCGCGTAGGTGGTTCGTTAAATTGGATGTTGAAATCCCCGGGCTCAACCGG
GGCACTGGATTCAAAAACGTTCAAGTAAAGTTTTGGAAAAGGGGGGGGAATT
TCCGGGCGCCCACGGGCAATGCGACAACATT

Strain NRCJ-26

GCAGGCCTAACACATGCAAGTCGAGCGGCAGCACGGGTACTTGTACCTGGTG
GCGAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGG
ATAACGCTCGGAAACGGACGCTAATACCGCATACGTCCTACGGGAGAAAGC
AGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAG
TTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGA

TGATCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGC
AGTGGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGT
GTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGCAGT
TACCTAATACGTATCTGTTTTGACGTTACCCCCAGAGTACGCACCCGGCCAAC
TCTGTGCCCGCAGCCCCGGTAAGACAGAGGGTGCACGCGTTAGATCGGAATT
ACTGGGGCGTAAAGCGCGCGTAGGTGGTTCGTTAAGTTGGATGTGAAATCCC
TGGGATCAACCTGGCAACTGCCTTCAAAACTGACAAACTAGACTTTGGTAGA
GGGGTGGTGGAGTTCACTGCTGCGCGTGCAATGTGTCATCTATAAGAGGAGC
ACCACTGGGGGAAGGAATC

Strain NRCJ-27

AGGCCTAACACATGCAAGTCGAGCGGATGACGGGAGCTTGCTCCTTGATTCA
GCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGGACAAC
GTTTCGAAAGGAACGCTAATACCGCATACGTCCTACGGGAGAAAGCAGGGG
ACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAGTTGGTG
GGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGATGATCA
GTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGTGG
GGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGTGTGAA
GAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGCAGTAAGCG
AATACCTTGCTGTTTTGACGTTACCGACAGAATAAGCACCGGCTAACTCTGTG
CCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTACTGGGC
GTAAAGCGCGCGTAGGTGGTTCGTTAAGTTGGATGTGAAAGCCCCGGGCTCA
ACCTGGGAACTGCCTCCAAAACTGGCCGCTAGAGTACGGGAGAGGGGGGGC
TAAAATTCTCAAGGATTCAACGACTCGTTGACATCGTTTACGGCACGCCCCAC
CCAGATGCCTAATCCCTGGTTTGCTCCCAGCCTTTTCGCACCCCAAAGCTAGT
AAACAACCAGGTGTTGACTTCTGGAAGGCGCGCCTCCAATATCTCAACATTC
ACCGCTACCCCGTGAAAATTCAACCGCGCTCCAGACATATTACTTGCCGTCTG
GGGGCGAATGCCCGCGGGGTTCACAGGCATTGAATTGCCAGGTGACCAGACG
ACCTGCTGCACCATGTGGCTAATTTCGTAGCCACTCCAATATCCCTCCCTAGG
GCTCACAAGCCCCAGCACTCTCACGTAGTGGAGTGGATTGCTTTGGT

Strain NRCJ-28

TGCGCAGGCCTAACACATGCAAGTCGAGCGGATGAAGGGAGCATTGCTCCTG
AATTCAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGG

GACAACGTTTCGAAAGGAACGCTAATACCGCATACGTCCTACGGGAGAAAGC
AGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAG
TTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGA
TGATCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGC
AGTGGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGT
GTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGTTGT
AGATTAATACTCTGCAATTTTGACGTTACCGACAGAATAAGCACCGGCTCACT
CTGTGCCAGCACCCCCGGTGATACAGAGAGGGGAAGCGCTTAAAGTAGTTTC
TGGGCGTAAAACGCGCGCATACGTGTGTCTAAAACTGAGATGAAAAATCCGA
GTTCACACCTTGGGAACTGCATCCAAAAAGTGGTCACCTAAAATTCTGGAAC
GGGGCGGTTGAAATCTCCAGGGCTCCCGATGGCTTGTTTACATTCTTTA

Strain NRCJ-29

GCAGGCCTAACACATGCAAGTCGAGCGGCAGCACGGGTACTTGTACCTGGTG
GCGAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGG
ATAACGCTCGGAAACGGACGCTAATACCGCATACGTCCTACGGGAGAAAGC
AGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAG
TTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGA
TGATCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGC
AGTGGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGT
GTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGCAGT
TACCTAATACGTAATTGTTTTGACGTTACCGACAGAATAAGCACCGGCTAACT
CTGTGCCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTAC
TGGGCGTAAAGCGCGCGTAGGTGGTTCGTTAAGTTGGATGTGAAATCCCCGG
GCTCAACCTGGGAACTGCGTTCAAAACTGAGAGCTAGAGTATGGTGGAGGGT
GGTGG

Strain NRCJ-30

TCGAACGGCAGCACAGAGGAGCTTGCTCCTTGGGTGGCGAGTGGCGGACGGG
TGAGGAATGCATCGGAATCTGCCTATTTGTGGGGGATAACGTAGGGAAACTT
ACGCTAATACCGCATACGTCCTACGGGAGAAAGTGGGGGACCGCAAGGCCTC
ACGCAGATAGATGAGCCGATGCCGGATTAGCTAGTTGGCGGGGTAAAGGCCC
ACCAAGGCGACGATCCGTAGCTGGTCTGAGAGGATGATCAGCCACACTGGAA
CTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGTGGGGAATATTGGACA

ATGGGCGCAAGCCTGATCCAGCCATGCCGCGTGTGTGAAGAAGGCCTTCGGG
TTGTAAAGCACTTTTGTCCGGAAAGAAAAGCGCTCGATTAATACTCGGGTGTT
ATGACGGTACCGGAAGAATAAGCACCGGCTAACTTCGTGCCAGCAGCCGCGG
TAATACGAAGGGTGCAAGCGTTACTCGGAATTACTGGGCGTAAAGCGTGCGT
AGGTGGTTTGTTAAGTCTGATGTGAAAGCCCTGGGCTCAACCTGGGAACTGC
ATTGGAAACTGGCTTACTAGAGTGCGGTAGAGGGGTGTGGAATTCCCGGTGT
AGCAGTGAAATGCGTAGATATCGGGAGGAACATCTGTGGCGAAGGCGACAC
CCTGGGCCAGCACTGACACTGAGGCACGAAAGCGTGGGGAGCAAAACAGGA
TTAGATACCCTGGTAGTCCACGCCCCTAAACGATGCGAACTGGATGTTTGGG
GGCAACTTGGCCCCTCAGTTCTAAAGCTAACGCGTTTAAGTTCGCCCCCTGGA
AAGTCCGTTCGCACGACTGAAACACAAAAGGAAATTGAAGGGGAGCGCGGC
CAAAGACGGTCGGGGTGGTGGGTTTAATTTAAGAGGACGGGCAGAGAACAA
TACCTTCTACTTGCCACTGTCACGGAACTGCCACTATTTCCGAGTAGTTGGAT
TTTTGGTATAGGGGACGCACGATAGAAGACTGGC

Strain NRCJ-31

TGCCTAATACATGCAAGTCGAGCGAATGGATATAGAGAGCTTGCTCTTAAGA
AGTTAGCGGCGGACGGGTGAGTAACACGTGGGTAACCTGCCCATAAGACTGG
GATAACTCCGGGAAACCGGGGCTAATACCGGATAATATTTTGAACTGCATGG
TTCGAAATTGAAAGGCGGCTTCGGCTGTCACTTATGGATGGGCCCCCGTCCCA
ATTCCAGTTTGTGAAGGACCGGCTCACCAAGGCAACGATCCTTACCCAAATG
AGAAGGGAATCGGCAAACTGGACTGAGACACGGCCAAACTCCTACGGGAGG
CACAGTAGGGAATCTTCCGCAATGGAAAAAGTCTGACGGACAACGCCGCGTG
AGTGATGAAGGCTTTCGGGTCGTAAACTCTGTTGTTGGGAAAACAAGTGCTA
TTGAATAAGCTGGACCTTGACGTACATAACCAGAAAGCCCTGCTAACTACGT
GCCACACCGCGTGATACTAGTTGCAAGATATCCGAATTTTTGGCGTAAGCCG
CGCAGGTGGTTTTTAATTAGATGTACACCCCCGGTTCTCCGTGTGGGTCATTG
AACTGGGACACTTACTGCAAAGAAGAAAGTGGATTTCCATGTGTACGGTGAA
ATGCTAGTGTATGGCGGAACACCTTGCCTATGCGAACATCAGGTTGAAACTG
CCACGGGGCTCGAAACCTTGGGTCCATTTGGAATAGAAGCGCGGCAGTCCCC
CCCAAACAAGATTGCAAATGAATAACGGTTTCCGCCATAGTGCGTCTTACAA
ATTAAAAAACCCACCGGGGCTTACCGCAACATGCTAAACTAATAGGAATTAC
ATGCGCCCCCCCGCCGCGGACATGTGGTTAATTCAAGCACGTCAAAGACCTA
CCAAGTCTGAATTCTTTGACAACCCTTTAGATGAGATTCACTTCTGACCGAGT
GCCCGGGAATCATGTTTTCCTCAATACTATCT

Strain NRCJ-32

ATGCGCATGCGCGTGCCTAATACACTGCAAGCTCGAGCGAACTGGATCAGAG
AGCTTGCTCTTAAGAAGCTAGCGGCGGACGGGTGAGTAACACGTGGGTAACC
TGCCCATAAGACTGGGATAACTCCGGGAAACCGGGGCTAATACCGGATAATA
TTTTGAACTGCATGGTTCGAAATTGAAAGGCGGCTTCGGCTGTCACTTATGGA
TGGACCCGCGTCGCATTAGCTAGTTGGTGAGGTAACGGCTCACCAAGGCAAC
GATGCGTAGCCGACCTGAGAGGGTGATCGGCCACACTGGGACTGAGACACG
GCCCAGACTCCTACGGGAGGCAGCAGTAGGGAATCTTCCGCAATGGACGAA
AGTCTGACGGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAAC
TCTGTTGTTAGGGAAGAACAAGTGCTAGTTGAATAAGCTGGCACCTTGACGG
TACCTAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACG
TAGGTGGCAAGCGTTATCCGGAATTATTGGGCGTAAAGCGCGCGCAGGTGGT
TTCTTAAGTCTGATGTGAAAGCCCACGGCTCAACCGTGGAGGGTCATTGGAA
ACTGGGAGACTTGAGTGCAGAAGAGGAAAGTGGAATTCCATGTGTAGCGGTG
AAATGCGTAGAGATATGGAGGAACACCAGTGGCGAAGGCGACTTTCTGGTCT
GTAACTGACACTGAGGCGCGAAAGCGTGGGGAGCAAACAGGATTAGATACC
CTGGTAGTCCACGCCGTAAACGATGAGTGCTAAGTGTTAGAGGGTTTCCGCC
CTTTAGTGCTGAAGTTAACGCATTAAGCACTCCGCCTGGGGAGTACGGCCGC
AAGGCTGAAACTCAAAGGAATTGACGGGGCCCGCACAAGCGGTGGAGCATG
TGGTTTAATTCGAAGCAACGCGAAGAACCTTACCAGGTCTTGACATCCTCTGA
AAACCCTAGAGATAGGGCTTTCTCCTTCGGGAGCAGAGTGACAGTGGTGCAT
GGTTGTCGTCAGCTCGTGTCGTGAGATGTTGGGTTTAGTCCCGCACGAGCGCA
CCCTTGATCCTAGGTGGCAATCATAGTGGCACCTCTAGTGACTGCTGTGACAA
ACCCGGAGAGGTGGGAAATGAACCGTCA

Strain NRCJ-33

TCGAGCGAATGGATAAGAGAGCTTGCTCTCAAGAAGTTAGCGGCGGACGGGT
GAGTAACACGTGGGTAACCTGCCCATAAGACTGGGATAACTCCGGGAAACCG
GGGCTAATACCGGATAACATTTTGAACTGCATGGTTCGAAATTGAAAGGCGG
CTTCGGCTGTCACTTATGGATGGACCCGCGTCGCATTAGCTAGTTGGTGAGGT
AACGGCTCACCAAGGCAACGATGCGTAGCCGACCTGAGAGGGTGATCGGCC
ACACTGGGACTGAGACACGGCCCAGACTCCTACGGGAGGCAGCAGTAGGGA
ATCTTCCGCAATGGACGAAAGTCTGACGGAGCAACGCCGCGTGAGTGATGAA
GGCTTTCGGGTCGTAAAACTCTGTTGTTAGGGAAGAACAAGTGCTAGTTGAA

TAAGCTGGCACCTTGACGGTACCTAACCAGAAAGCCACGGCTAACTACGTGC
CAGCAGCCGCGGTAATACGTAGGTGGCAAGCGTTATCCGGAATTATTGGGCG
TAAAGCGCGCGCAGGTGGTTTCTTAAGTCTGATGTGAAAGCCCACGGCTCAA
CCGTGGAGGGTCATTGGAAAACTGGGAGACTTGAGTGCACAAAAGGAAAA
TGGGATTCCCCGTGTAACGGTGTAATGTGTAGGAAATAAATGAGAACACCCC
TGGGGGCAGGGGCCATTCTTGGCTTTTGCCCCCTCCCATTGCGGCGCAAACCC
GGGGGAACAAAAGAGGAAAAGGATGTCCTGGTTCGCCCCCCCCAAAAC
GAACAAGTGCCTAGTTGTTAGGAGGGTTTCCCCCCCTATTACTTGCTAAATC
TTAACCGAATTAAAAAAACCCCCCCGGGGGAAGAACGGGCCGGCGAGGAC
AAAAAAAAAAAAAAAGAAAATAAACGGAGGGCCCCCCAAACGCGGGTGCA
GACATTGTGGTTTAAAATTCGAAGCCCAACACAAAAAAAACCTTACCGGAGG
TTCTGGGACAATCCTTCTAGAAAAAACCCCAAAATATAAGGGGTCTTCCCCCT
TTAGAGAACAAGAAATGACACAGGGGCGTACCAAAGGGTATTGTCGCTACG
ACACACCTGCGTCGAGGGGAAGATGGTTGGGGGGATAAAGTCTCCTCACACA
AAACTACCGCGCGCAAACCGCTTTGTGGAATCCC

Strain NRCJ-34

GTGCCTAATACATGCAAGTCGAGCGAATGGATTGAGAGCTTGCTCTCAAGAA
GTTAGCGGCGGACGGGTGAGTAACACGTGGGTAACCTGCCCATAAGACTGGG
ATAACTCCGGGAAACCGGGGCTAATACCGGATAACATTTTGAACTGCATGGT
TCGAAATTGAAAGGCGGCTTCGGCTGTCACTTATGGATGGACCCGCGTCGCA
TTAGCTAGTTGGTGAGGTAACGGCTCACCAAGGCAACGATGCGTAGCCGACC
TGAGAGGGTGATCGGCCACACTGGGACTGAGACACGGCCCAGACTCCTACGG
GAGGCAGCAGTAGGGAATCTTCCGCAATGGACGAAAGTCTGACGGAGCAAC
GCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAACTCTGTTGTTAGGGAAG
AACAAGTGCTAGTTGAATAAGCTGGCACCTTGACGGTACCTAACCAGAAAGC
CACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGGTGGCAAGCGTTA
TCCGGAATTATTGGGCGTAAAGCGCGCGCAGGTGGTTTCTTAAGTCTGATGTG
AAAGCCCACGGCTCAACCGTGGAGGGTCATTGGAAACTGGGAGACTTGAGTG
CAGAAGAGGAAAGTGGAATTCCATGTGTAGCGGTGAAATGCGTAGAGATAT
GGAGGAACACCAGTGGCGAAGGCGACTTTCTGGTCTGTAACTGACACTGAGG
CGCGAAAGCGTGGGGAGCAAACAGGATTAGATACCCTGGTAGTCCACGCCGT
AAACGATGAGTGCTAAGTGTTAGAGGGTTTCCGCCCTTTAGTGCTGAAGTTA
ACGCATTAAGCACTCCGCCTGGGGAGTACGGCCGCAAGGCTGAAACTCAAAG
GAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGGTTTAATTCGAAGCA

ACGCGAAGAACCATACCAGGTCTTGACATCCTCTGAAAATCCTAACACGATA
GGGCTTCTCATTCGC

Strain NRCJ-35

CGGAGCCTGCGCGTGCCTAAACATGCAAGTCAGCGAAAGATAAGGAGCTTGC
TCCTTCGATGTTAGCGGCGGAGGGGTGAGTAACACGTGGGCAACCTACCTTA
TAGTTTGGGATAACTCCGGGAAACCGGGGCTAATACCGAATAATCTGTTTCA
CCTCATGGTGAAACACTGAAAGACGGTTTCGGCTGTCGCTATAGGATGGGCC
CGCGGCGCATTAACTAGTTGGTGAGGTAACGGCTCACCAAGGCGACGATGCG
TAGCCCACCTGAGAGGGTGATCGGCCACACTGGGACTGAAACACGGCCCATA
CTCCTACGGGAGGCAGCAGTGGGGAATCTTCCACAATGGGCAAAAGCCTGAT
GGAGCAACGCCGCGTGAGTGAAGAAGGATTTCGGTTCGTAAAACTCTGTTGT
GAGGGAAGAACAAGTACAGTAATAACTGGCTGTACCTTGACGGTACCTTATT
AAAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGGTGGC
AAGCGTTGTCCGGAATTATTGGGCGTAAAGCGCGCGCAGGTGGTTTCTTAAG
TCTGATGTGAAAGCCCACGGCTCAACCGTGGAGGGTCATTGAAAACTGGGAG
ACTTGAGTGCAGAAGAGGATAGTGGAATTCCAAGTGTAGCGGTGAAATGCGT
AGAGATTTGGAGGAACACCAGTGGCGAAGGCGACTATCTGGTCTGTAACTGA
CACTGAGGCGCGAAAGCGTGGGGAGCAAACAGGATTAGATACCCTGGTAGT
CCACGCCGTAAACGATGAGTGCTAAGTGTTAGGGGGGTTTCCGCCCATTAGT
GCTGCAGCTAACGCATTAAGCACTCCGCCTGGGGAGTACGGTCGCAAGGCTG
AAACTCAGAGGAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGGTTT
TATTAGCAGCAACGCGAAGAACATTACCAGGTCTTGACATCCTGTTGACCAC
TGAAAAGAAAGTTGTTCTCCCCTTCGGGGGACAACGGTGACTGGTGGCTGCA
TGGTTGTCGTCAGCTCGTGTCGTGAGATGGTGTGATTTAGTCCAGCACCGAGC
GCCAACTCGATGATCCTTAGCTGCCATCATTTTAGTTGGGTACTCTGAGCTGA
CCTGGCTGTTGAACAACCGGAGAGTGGATGGACGATTCCATCATGCACTGCC
CTCTTTATCGAGCGCGTGCGTACCTTAC

Strain NRCJ-36

TGCAGCTTGCGCGTGCCTAATACATGCAAGTCGAGCGAATGGATTGAGAGCT
TGCTCTCAAGAAGTTAGCGGCGGACGGGTGAGTAACACGTGGGTAACCTGCC
CATAAGACTGGGATAACTCCGGGAAACCGGGGCTAATACCGGATAACATTTT
GAACTGCATGGTTCGAAATTGAAAGGCGGCTTCGGCTGTCACTTATGGATGG

ACCCGCGTCGCATTAGCTAGTTGGTGAGGTAACGGCTCACCAAGGCAACGAT
GCGTAGCCGACCTGAGAGGGTGATCGGCCACACTGGGACTGAGACACGGCC
CAGACTCCTACGGGAGGCAGCAGTAGGGAATCTTCCGCAATGGACGAAAGTC
TGACGGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAACTCTG
TTGTTAGGGAAGAACAAGTGCTAGTTGAATAAGCTGGCACCTTGACGGTACC
TAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGG
TGGCAAGCGTTATCCGGAATTATTGGGCGTAAAGCGCGCGCAGGTGGTTTCT
TAAGTCTGATGTGAAAGCCCACGGCTCAACCGTGGAGGGTCATTGGAAACTG
GGAGACTTGAGTGCAGAAGAGGAAAGTGGAATTCCATGTGTAGCGGTGAAA
TGCGTAGAGATATGGAGGAACACCAGTGGCGAAGGCGACTTTCTGGTCTGTA
ACTGACACTGAGGCGCGAAAGCGTGGGGAGCAAACAGGATTAGATACCCTG
GTAGTCCACGCCGTAAACGATGAGTGCTAAGTGTTAGAGGGTTTCCGCCCTTT
AGTGCTGAAGTTAACGCATTAAGCACTCCGCCTGGGGAGTACGGCCGCAAGG
CTGAAACTCAAAGGAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGG
TTTAATTCGAAGCAACGCGAAGAACCTTACCAGGTCTTGACATCCTCTGAAA
ACCCTAGAGATAGGCTTCTCCTTCGGGAGCAGAGTGACAGGTGGTGCATGGT
TGTCGTCAGCTCGTGTCGTGAGATGTTGGGTTTAGTCCGCACCGAGCGCAAC
CCTTGGATCTTAGTTTGCCATCATTAGTGGTCACCTCTAAGTGACTGCCGTGA
CAACCGAGGAATGTGCGATGACGTCCGAATCAATCCATTGAACACAT

Strain NRCJ-37

TGCAGCTTGCGCGTGCCTAATACATGCAAGCCGAGCGAATGGATTGAGAGCT
TGCTCTCAAGAAGTTAGCGGCGGACGGGTGAGTAACACGTGGGTAACCTGCC
CATAAGACTGGGATAACTCCGGGAAACCGGGGCTAATACCGGATAACATTTT
GAACTGCATGGTTCGAAATTGAAAGGCGGCTTCGGCTGTCACTTATGGATGG
ACCCGCGTCGCATTAGCTAGTTGGTGAGGTAACGGCTCACCAAGGCAACGAT
GCGTAGCCGACCTGAGAGGGTGATCGGCCACACTGGGACTGAGACACGGCC
CAGACTCCTACGGGAGGCAGCAGTAGGGAATCTTCCGCAATGGACGAAAGTC
TGACGGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAACTCTG
TTGTTAGGGAAGAACAAGTGCTAGTTGAATAAGCTGGCACCTTGACGGTACC
TAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGG
TGGCAAGCGTTATCCGGAATTATTGGGCGTAAAGCGCGCGCAGGTGGTTTCT
TAAGTCTGATGTGAAAGCCCACGGCTCAACCGTGGAGGGTCATTGGAAACTG
GGAGACTTGAGTGCAGAAGAGGAAAGTGGAATTCCATGTGTAGCGGTGAAA
TGCGTAGAGATATGGAGGAACACCAGTGGCGAAGGCGACTTTCTGGTCTGTA

ACTGACACTGAGGCGCGAAAGCGTGGGGAGCAAACAGGATTAGATACCCTG
GTAGTCCACGCCGTAAACGATGAGTGCTAAGTGTTAGAGGGTTTCCGCCCTTT
AGTGCTGAAGTTAACGCATTAAGCACTCCGCCTGGGGAGTACGGCCGCAAGG
CTGAAACTCAAAGGAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGG
TTTAATTCGAAGCAACGCGAAGAACCTTACCAGGTCTTGACATCCTCTGAAA
ACCCTAGAGATAGGGCTTCTCCCTTCGGGAGCAGAGTGACAGGTGGTGCATG
GGTTGTCGTCAGCTCGTGTCGTGAGATGTTGGGTTTAGTCCCGCACGAGCGCA
CCCTGATCTTAGTTTGCCAATCATAGTGGCACTCTAGTGACTGGCGTGACGAC
GGAGGAAGGTGGGATGACGTTCCAATCATTCACTGGCAC

Strain NRCJ-38

ATGCCCTTGCGCGTGCCTAATACATGCAAGCTCGAGCGAATTGGATTGAGAG
CTTGCTCTCAAGAAGTTAGCGGCGGACGGGTGAGTAACACGTGGGTAACCTG
CCCATAAGACTGGGATAACTCCGGGAAACCGGGGCTAATACCGGATAACATT
TTGAACTGCATGGTTCGAAATTGAAAGGCGGCTTCGGCTGTCACTTATGGATG
GACCCGCGTCGCATTAGCTAGTTGGTGAGGTAACGGCTCACCAAGGCAACGA
TGCGTAGCCGACCTGAGAGGGTGATCGGCCACACTGGGACTGAGACACGGCC
CAGACTCCTACGGGAGGCAGCAGTAGGGAATCTTCCGCAATGGACGAAAGTC
TGACGGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAACTCTG
TTGTTAGGGAAGAACAAGTGCTAGTTGAATAAGCTGGCACCTTGACGGTACC
TAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGTAGG
TGGCAAGCGTTATCCGGAATTATTGGGCGTAAAGCGCGCGCAGGTGGTTTCT
TAAGTCTGATGTGAAAGCCCACGGCTCAACCGTGGAGGGTCATTGGAAACTG
GGAGACTTGAGTGCAGAAGAGGAAAGTGGAATTCCATGTGTAGCGGTGAAA
TGCGTAGAGATATGGAGGAACACCAGTGGCGAAGGCGACTTTCTGGTCTGTA
ACTGACACTGAGGCGCGAAAGCGTGGGGAGCAAACAGGATTAGATACCCTG
GTAGTCCACGCCGTAAACGATGAGTGCTAAGTGTTAGAGGGTTTCCGCCCTTT
AGTGCTGAAGTTAACGCATTAAGCACTCCGCCTGGGGAGTACGGCCGCAAGG
CTGAAACTCAAAGGAATTGACAGGGGCCCGCACAAGCGGTGGAGCATGTGG
TTTAATTCGAAGCAACGCGAAGAACCTTACCAGGTCTTGACATCCTCTGAAA
ACCCTAGAGATAGGGCTTTCTCCCTTCGGGAGCAGAGTGACAGGTGTGCATG
GTTGTCGTCAGCTCGTGTCGTGGAGATGTTGGTTTAGTCCCGCACGAGCGCAC
CCTGATCTAGTTGCCATTCATAGTGGCACTCTAGGTGACTGCCGTTGACAACC
GGAGCAGTGGGATGGACGCGCTCGAATTCCATCA

Strain NRCJ-39

TGAACTTGCGCAGGCCTAACACATGCAAGCTCGAGCGGATGAAGAGAGCTTG
CTCTCTGATTCAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTA
GTGGGGGACAACGTTTCGAAAGGAACGCTAATACCGCATACGTCCTACGGGA
GAAAGCAGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATT
AGCTAGTTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTG
AGAGGATGATCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGA
GGCAGCAGTGGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCC
GCGTGTGTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAG
GGTTGTAGATTAATACTCTGCAATTTTGACGTTACCGACAGAATAAGCACCG
GCTAACTCTGTGCCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTAATCG
GAATTACTGGGCGTAAAGCGCGCGTAGGTGGTTTGTTAAGTTGGATGTGAAA
GCCCCGGGCTCAACCTGGGAACTGCATTCAAAACTGACAAGCTAGAGTATGG
TAGAGGGTGGTGGAATTTCCTGTGTAGCGGTGAAATGCGTAGATATAGGAAG
GAACACCAGTGGCGAAGGCGACCACCTGGACTGATACTGACACTGAGGTGC
GAAAGCGTGGGGAGCAAACAGGATTAGATACCCTGGTAGTCCACGCCGTAA
ACGATGTCAACTAGCCGTTGGGAGCCTTGAGCTCTTAGTGGCGCAGCTAACG
CATTAAGTTGACCGCCTGGGGAGTACGGCCGCAAGGTTAAAACTCAAATGAA
ATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGGTTTAATTCGAAGCAAC
GCGAAAGAACCTTACCAGGCCTTGACATCCAATGAACTTTCCAGAGATGGAT
TGGTGCCTTTCGGGAAACATTGAGACAGGTGCTGCATGGCTGTCGTCAGCTC
GTGTCCGTGGAGATGTTGGGTTAAGTCCCGTAACGAGCGCAACGCTTGTCCTT
AGTTACCAGCACTTAATGGTGGCACTCTAAGGAAACTGCCGGATGACAAACC
GGAAGCAGGTTGGGGATGACCGGTACAGTTACATACATAGAGCACTCACATA
TATACGAGGCACCACT

Strain NRCJ-40

GCTCAGAAGATGGTGAGAGTGGCGCACGGGTGCGTAACGCGTGAGCAACCT
ACCTCTATCAGGGGGATAGCCTCTCGAAAGAGAGATTAACACCGCATAACAT
CAACAGTTCGCATGTTCGGTTGATTAAATATTTATAGGATAGAGATGGGCTCG
CGTGACATTAGCTAGTTGGTAGGGTAACGGCTTACCAAGGCGACGATGTCTA
GGGGCTCTGAGAGGAGAATCCCCCACACTGGTACTGAGACACGGACCAGACT
CCTACGGGAGGCAGCAGTAAGGAATATTGGTCAATGGGCGGAAGCCTGAAC
CAGCCATGCCGCGTGCAGGATGACTGCCCTATGGGTTGTAAACTGCTTTTGTC

CAGGAATAAACCCAGATACGTGTATCTGGCTGAATGTACTGGAAGAATAAGG
ATCGGCTAACTCCGTGCCAGCCGCCGCGGTATACGGGGGAACCCAGCGTTA
TCCCGATTTATTGGGTTTAAAGGGGTGCTTAGCCGGAAATTAATTCAGGGGTG
AAATACGGTGGCTCAACCATCGCAGTGCCTTTGATCCTGATTGGCTTGAATCC
ATTTGAAATTGGGCCGGAAAAAAACAAGTA

Strain NRCJ-41

TGCGCTGCGCAGGCCTAACACATGCAAGTCGGCGGATGAAGAGAGCTTGCTC
TCTGATTCAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTG
GGGGACAACGTTTCGAAAGGAACGCTAATACCGCATACGTCCTACGGGAGAA
AGCAGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGC
TAGTTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGA
GGATGATCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGC
AGCAGTGGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCG
TGTGTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGT
TGTAGAT

Strain NRCJ-42

CTGCACCTGCGCATGCCTTAACATGCAAGTCGAGCGGCAGCACGGGCTTCTG
CCTGTTGGCGAGTGGCGAACGGGTGAGTAATACATCTGAACGTGCCGTGTGT
TGGGGGATAACAAGTCGAAAGATTAGCTGATACCGCATACGAACTGATGGTG
AAAGCGGGGGACCGCATGGCCTATGGCTACACGAGCGGCCGATGTCTGATTA
GCTACTTGGTGGGGTAAAAGCCTACCAACGCCACAATCAGGCGCTGGTCCGA
AAGGACGATCAACCACACTGGGACTGAAACACGGACCAGACTCCTACCGGA
GGCACCACTGGGGAATTTTGGACAATGGGGGCAACCCTGATCCAACAATGCC
GCGTGTGTGAAGAAGGCCTTCGGGTTGTAAAGCACTTTTGTCCGGAAAGAAA
TGGCCTGGGTGAATACCCCGGGTCGCTGCCGGTACCGGAACAATAAGCACCG
GCTAACTACGTGCCAACTACCGCGGTAATACGTAGGGTGCGAGCGTTAATCA
GAATTACTGGGCGTAAAGCGTGCGCAAGCGGTTTTGTAAGACAGGCGTGAAA
TCCCCGAGCTTAACTTGGGAATGGCGCTTGTGACTGATTGGCTACAGTATGTC
TTGGGGCGTAGAATTCCACGTGTAGCAGTGAAATGCGTATAGATGTCGAGGA
ATACCGATGGCGCACGCATGCCCCTGGCACGTCACTGACGCTCATGCGACAC
AGCGTGGGGAGCACACAGGATTAGATACCCTGGTAGTCCACGCCCTAAACGA
TGTCAACTACGATGATGGGGATTTATTTCTTCAGTTACCGTACCTTACGCGCT

GAAGTTGACCGGCCTGGGGAGTACGGTCGCGAGGATTAAAACCTCAAAGGTA
AATGACTCGGGACCACGTACCAGCGGCGCATGAATGTGGGTTAATTCTTGTG
CATCGACGTAAAACCATACCCTACCCATTGATATGCCGGTCTATCGACATCAT
ATAAGCATTTCTGATGCCCTAAAAGGGTAAACTTGTACAGCAGGATAGCTGC
ATCGGCTTGTGTTCATCGTCTTGTTCGTCAGATGTTGGGTTTAAGATTCCTGCG
ATCAAGCTCCAACCACTTGTCTTTAGCTTGCTGACTCTAAGATACCCTACCAA
ACAGAACTTGCCCGCTGACAAAGCCGCAATGCAAGGTGGAGGAATGCGACG
ATGCAGGTCGTGCATAGTACTTACAAGTTACGGGCTTTCGATATTAATCGATG
CTGTAGCGAGTACATGCGGAGTGCGAATTTGGCCAAGGTCGGACAGAAAAG

Strain NRCJ-43

CACCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGTGCAACCC
ACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCACCG
CGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCGAGTTGC
AGACTGCGATCCGGACTACGATCGGTTTTATGGGATTAGCTCCACCTCGCGGC
TTGGCAACCCTTTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGTAAG
GGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGCAGT
CTCCTTAGAGTGCCCACCATTACGTGCTGGTAACTAAGGACAAGGGTTGCGC
TCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCCATG
CAGCACCTGTCTCAATGTTCCCGAAGGCACCAATCCATCTCTGGAAAGTTCAT
TGGATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTAAACCACATG
CTCCACCGCTTGTGCGGGCCCCCGTCAATTCATTTGAGTTTTAACCTTGCGGC
CGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAGAGCTCA
AGGCTCCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACCAGGGTATC
TAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATCAGTCCAGG
TGGTCGCCTTCGCCACTGGTGTTCCTTCCTATATCTACGCATTTCACCGCTACA
CAGGAAATTCCACCACCCTCTACCATACTCTAGCTCGCCAGTTTTGGATGCAG
TTCCCAGGTTGAGCCCGGGGATTTCACATCCAACTTAACGAACCACCTACGC
GCGCTTTACGCCCAGTAATTCCGATTAACGCTTGCACCCTCTGTATTACCGCG
GCTGCTGGCACAGAGTTAGCCCGGTGC

Strain NRCJ-44

AGGCCTAAACATGCAGTCGAGCGGATGAAGGGAGCTTGCTCCTGAATTCAGC
GGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGGACAACGT

TTCGAAAGGAACGCTAATACCGCATACGTCCTACGGGAGAAAGCAGGGGAC
CTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAGTTGGTGAG
GTAATGGCTCACCCAGGGCACCATCCCTAACTGGTCCGAAAGGATTATCAAT
TCACTGGAAATTAACACGGGTCAAAAACTCCCAGGAGGCGACCGGTGCGAA
AAATTGGACAAAAGGGTTATCTTGCCCCCCGATGCCCATGTGTGAAATGCTCT
TCTGACTGAACAGACTTTAAATTGGGAAGAAAGGTTTACGATAAACTGTGCT
ATCTTTCCCATCCCAACCGAAAGAACCCCTGCTTATTCGGTAAGTACTGCCGC
GGTAAAACAGAGGGTGCATGCGTTAATCTGAATTACTGGGCGTAAAGCGCGC
GTCGGTGGTTCGTTAAGTTGGTTGTTAAAATCCCCGTTCAAACCCTGGGAACT
GCATCCCAAAAGCTGGCAAGCTTAAGTCTTTTACAGCGTCACTAGA

Strain NRCJ-45

TCGAGCGAACTGGATTAGAGAGCTTGCTCTCAAGAAGTTAGCGGCGGACGGG
TGAGTAACACGTGGGTAACCTGCCCATAAGACTGGGATAACTCCGGGAAACC
GGGGCTAATACCGGATAATATTTTGAACTGCATGGTTCGAAATTGAAAGGCG
GCTTCGGCTGTCACTTATGGATGGACCCGCGTCGCATTAGCTAGTTGGTGAGG
TAACGGCTCACCAAGGCAACGATGCGTAGCCGACCTGAGAGGGTGATCGGCC
ACACTGGGACTGAGACACGGCCCAGACTCCTACGGGAGGCAGCAGTAGGGA
ATCTTCCGCAATGGACGAAAGTCTGACGGAGCAACGCCGCGTGAGTGATGAA
GGCTTTCGGGTCGTAAAACTCTGTTGTTAGGGAAGAACAAGTGCTAGTTGAA
TAAGCTGGCACCTTGACGGTACCTAACCAGAAAGCCACGGCTAACTACGTGC
CAGCAGCCGCGGTAATACGTAGGTGGCAAGCGTTATCCGGAATTATTGGGCG
TAAAGCGCGCGCAGGTGGTTTCTTAAGTCTGATGTGAAAGCCCACGGCTCAA
CCGTGGAGGGTCATTGGAAACTGGGAGACTTGAGTGCAGAAGAGGAAAGTG
GAATTCCATGTGTAGCGGTGAAATGCGTAGAGATATGGAGGAACACCAGTGG
CGAAGGCGACTTTCTGGTCTGTAACTGACACTGAGGCGCGAAAGCGTGGGGA
GCAAACAGGATTAGATACCCTGGTAGTCCACGCCGTAAACGATGAGTGCTAA
GTGTTAGAGGGTTTCCGCCCTTTAGTGCTGAAGTTAACGCATTAAGCACTCCG
CCTGGGGAGTACGGCCGCAAGGCTGAACTCAAAGGAATTGACGGGGGCCCG
CACAAGCGGTGGAGCATGTGGTTTAATTCGAAGCACGCGAAGAACCTTACCA
GGTCTTGACATCCTCTGAAACCCAAGAGATAGAGCTTCGTCCTTCCT

Strain NRCJ-46

GTCCCCTTCGCCCTCCCCCCGGAAACCGGTTGGGCCATGAGCTTCGGGTGTTA
CCAACTTTCGTGACTTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCA
CCGCAGCGTTGCTGATCTGCGATTACTAGCGACTCCGACTTCATGGGGTCGAG
TTGCAGACCCCAATCCGAACTGAGACCGGCTTTTTGGGATTCGCTCCACCTTA
CGGTATCGCAGCCCTCTGTACCGGCCATTGTAGCATGCGTGAAGCCCAAGAC
ATAAGGGGCATGATGATTTGACGTCATCCCCACCTTCCTCCGAGTTGACCCCG
GCAGTCTCCCATGAGTCCCCGGCATAACCCGCTGGCAACATAGGACGAGGGT
TGCGCTCGTTGCGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAA
CCATGCACCACCTGTGCACCGACCTTACGGGGCACCCATCTCTGAGTGTTTCC
GGTGCATGTCAAGCCTTGGTAAGGTTCTTCGCGTTGCATCGAATTAATCCGCA
TGCTCCGCCGCTTGTGCGGGCCCCCGTCAATTCCTTTGAGTTTTAGCCTTGCG
GCCGTACTCCCCAGGCGGGGCACTTAATGCGTTAGCTGCGGCACGGAACTCG
TGGAATGAGCCCCACACCTAGTGCCCAACGTTTACGGCATGGACTACCAGGG
TATCTAATCCTGTTCGCTCCCCATGCTTTCGCTCCTCAGCGTCAGTTGCGGCCC
AGAGACCTGCCTTCGCCATCGGTGTTCCTCCTGATATCTGCGCATTCCACCGC
TACACCAGGAATTCCAGTCTCCCCTACCGCACTCTAGTCTGCCCGTACCCGAT
GCAAGCCCGAGGTTGAGCCTCGGGATTTCACACCAGACGCGACAGACCGCCT
ACGAGCTCTTTACGCCCAATAATTTCCGGACAAGCGCTTGCGCCCTACGTATT
ACCGCGGCTGCTGGCACGTAGTTAGCC

Strain NRCJ-47

GTGGCGCGTGCCTAATACATGCAAGTCGAGCGAATGGATATAGAGAGCTTGC
TCTCAAGAAGTTAGCGGCGGACGGGTGAGTAACACGTGGGTAACCTGCCCAT
AAGACTGGGATAACTCCGGGAAACCGGGGCTAATACCGGATAACATTTTGAA
CCGCATGGTTCGAAATTGAAAGGCGGCTTCGGCTGTCACTTATGGATGGACC
CGCGTCGCATTAGCTAGTTGGTGAGGTAACGGCTCACCAAGGCAACGATGCG
TAGCCGACCTGAGAGGGTGATCGGCCACACTGGGACTGAGACACGGCCCAG
ACTCCTACGGGAGGCAGCAGTAGGGAATCTTCTTCAATGGACGAAAGTCTGA
CGGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAACTCTGTTG
TTAGGGAAGAACAAGTGCTTGTTGAATAAGCTGGCCCCTTGGCCGGTCCCAA
ACCCAAAGCCCACGCTAACCTCCTGCCCTCCGCGCCGGTGTTCCTTA

Strain NRCJ-48

AAGAGCTTGCTCTTCGATTCAGCGGCGGACGGGTGAGTAATGCCTAGGAATC
TGCCTGGTAGTGGGGGACAACGTTTCGAAAGGAACGCTAATACCGCATACGT
CCTACGGGAGAAAGCAGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTA
GGTCGGATTAGCTAGTTGGTGGGGTAATGGCTCACCAAGGCGACGATCCGTA
ACTGGTCTGAGAGGATGATCAGTCACACTGGAACTGAGACACGGTCCAGACT
CCTACGGGAGGCAGCAGTGGGGAATATTGGACAATGGGCGAAAGCCTGATC
CAGCCATGCCGCGTGTGTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGT
TGGGAGGAAGGGCAGTAAGCGAATACCTTGCTGTTTTGACGTTACCGACAGA
ATAAGCACCGGCTAACTCTGTGCCAGCAGCCGCGGTAATACAGAGGGTGCAA
GCGTTAATCGGAATTACTGGGCGTAAAGCGCGCGTAGGTGGTTTGTTAAGTT
GGATGTGAAAGCCCCGGGCTCAACCTGGGAACTGCATCCAAAACTGGCAAGC
TAGAGTACGGTAGAGGGTGGTGGAATTTCCTGTGTAGCGGTGAAATGCGTAG
ATATAGGAAGGAACACCAGTGGCGAAGGCGACCACCTGGACTGATACTGAC
ACTGAGGTGCGAAAAGCGTGGGGAGCAAACAGGATTAGATACCCTGGTAGT
CCCACGCCGTAAACGATGTCAACTAACCGTTGGAATCCTTGAGATTTTATGTG
GCGCAGCTAACGCATTAAGTTGACCGCCCGGGGGGTACGGCCGCCGGTTA
AAAACACAAAATGAATTTGAAAGGGGGCCCGCACAAACAGATGGAGCAGGT
GGTTTTAGTTCTAATTCACAACAAAAACCTTAACCGGCCTTTGACTTCTAGGG
GCTTTGCAGAGATAGAATGGGGGCTTTTGGGCATTGTGAACACGTGAAAGAG
CAGCATGTAGAGCTATCATCACACCGATACGCTGGGAATAGTGCGGTGAACA
TCGACACACCAACGGTCACGCACTATACACAAGTGTCCGGCAGACGTATGTG
TGTGTGGCAGCATTTGATCAGTGACA

Strain NRCJ-49

CACCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGTGCAACCC
ACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCACCG
CGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCGAGTTGC
AGACTGCGATCCGGACTACGATCGGTTTTGTGAGATTAGCTCCACCTCGCGGC
TTGGCAACCCTCTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGTAA
GGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGCAG
TCTCCTTAGAGTGCCCACCATAACGTGCTGGTAACTAAGGACAAGGGTTGCG
CTCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCCAT
GCAGCACCTGTGTCAGAGTTCCCGAAGGCACCAATCCATCTCTGGAAAGTTC

TCTGCATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTAAACCACA
TGCTCCACCGCTTGTGCGGGCCCCGTCAATTCATTTGAGTTTTAACCTTGCG
GCCGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAAATCTC
AAGGATTCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACCAGGGTAT
CTAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATCAGTCCAG
GTGGTCGCCTTCGCCACTGGTGTTCCTTCCTATATCTACGCATTTCACCGCTAC
ACAGGAAATTCCACCACCCTCTACCGTACTCTAGCTCGCCAGTTTTGGATGCA
GTTCCCAGGTTGAGCCCCGGGGCTTTCACATCCAACTTAACGAACCACCTAC
GCGCGCTTTACGCCCAGTAATTCCCGATTAACGCTTGCACCCTCTGTATTACC
GCGGCTGCTGGCACAGAGTTAGCCC

Strain NRCJ-50

CACCCGTGGTAACCGTCCTCCCGAAGGTTAGACTAGCTACTTCTGGTGCAACC
CACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCACC
GCGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCGAGTTG
CAGACTGCGATCCGGACTACGATCGGTTTTGTGAGATTAGCTCCACCTCGCGG
CTTGGCAACCCTCTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGTA
AGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGCA
GTCTCCTTAGAGTGCCCACCATAACGTGCTGGTAACTAAGGACAAGGGTTGC
GCTCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCCA
TGCAGCACCTGTGTCAGAGTTCCCGAAGGCACCAATCCATCTCTGGAAAGTT
CTCTGCATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCGAATTAAACCAC
ATGCTCCACCGCTTGTGCGGGCCCCGTCAATTCATTTGAGTTTTAACCTTGC
GGCCGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAAATC
TCAAGGATTCCAACGGCTAGTTGACATCGTTTACGGCGTGGACTACCAGGGT
ATCTAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATCAGTCC
AGGTGGTCGCCTTCGCCACTGGTGTTCCTTCCTATATCTACGCATTTCACCGCT
ACACAGGAAATTCCACCACCCTCTACCGTACTCTAGCTCGCCAGTTTTGGATG
CAGTTCCCAGGTTGAGCCCGGGGCTTTCACATCCAACTTAACGAACCACCTA
CGCGCGCTTTACGCCCAGTAATTCCGATTAACGCTTGCACCCTCTGTATTACC
GCGGCTGCTGGCACAGAGTTAGCCCG

Strain NRCJ-51

AGGAAGCTTGCGCGTGCCTAATACATGCAAGACGAGCGAATTGGATTAGAGA
GCTTGCTCTCAAGAAGTTAGCGGCGGACGGGTGAGTAACACGTGGGTAACCT
GCCCATAAGACTGGGATAACTCCGGGAAACCGGGGCTAATACCGGATAATAT
TTTGAACTGCATGGTTCGAAATTGAAAGGCGGCTTCGGCTGTCACTTATGGAT
GGACCCGCGTCGCATTAGCTAGTTGGTGAGGTAACGGCTCACCAAGGCAACG
ATGCGTAGCCGACCTGAGAGGGTGATCGGCCACACTGGGACTGAGACACGG
CCCAGACTCCTACGGGAGGCAGCAGTAGGGAATCTTCCGCAATGGACGAAA
GTCTGACGGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAACT
CTGTTGTTAGGGAAGAACAAGTGCTAGTTGAATAAGCTGGCACCTTGACGGT
ACCTAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGGTAATACGT
AGGTGGCAAGCGTTATCCGGAATTATTGGGCGTAAAGCGCGCGCAGGTGGTT
TCTTAAGTCTGATGTGAAAGCCCACGGCTCAACCGTGGAGGGTCATTGGAAA
CTGGGAGACTTGAGTGCAGAAGAGGAAAGTGGAATTCCATGTGTAGCGGTGA
AATGCGTAGAGATATGGAGGAACACCAGTGGCGAAGGCGACTTTCTGGTCTG
TAACTGACACTGAGGCGCGAAAGCGTGGGGAGCAAACAGGATTAGATACCC
TGGTAGTCCACGCCGTAAACGATGAGTGCTAAGTGTTAGAGGGTTTCCGCCC
TTTAGTGCTGAAGTTAACGCATTAAGCACTCCGCCTGGGGAGTACGGCCGCA
AGGCTGAAACTCAAAGGAATTGACGGGGCCCGCACAAGCGGTGGAGCATGT
GGTTTAATTCGAAGCACGCGAAGACCCTTACCAGGTCTTGACATCCTCTGAA
AACCCTAGAGATAGGGCTTCTCCTTCGGGAGCAGAGTGACAGTGGTGCATGT
TGTCGTCAGCTCGTGTCGTGAGATGTTGGTTTAGTCCCGCACGAGCGCACCCT
GATCTTAGTTTGCATCATAGTAGTCACTCTAAGTGACTGCCGTGACAACGAGA
AGGTTGGATTGACGTCAAATCCATCATGTGACCT

Strain NRCJ-52

CCTACCGCACACCGTGGCAAGCGCCCTCCCGAAGGTTAAGCTACCTGCTTCT
GGTGCAACAAACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAAC
GTATTCACCGCAGCAATGCTGATCTGCGATTACTAGCGATTCCGACTTCATGG
AGTCGAGTTGCAGACTCCAATCCGGACTGAGATAGGGTTTCTGGGATTGGCT
TACCGTCGCCGGCTTGCAGCCCTCTGTCCCTACCATTGTAGTACGTGTGTAGC
CCTGGCCGTAAGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTT
GTCACCGGCGGTCTCCTTAGAGTTCCCACCATTACGTGCTGGCAACTAAGGA
CAAGGGTTGCGCTCGTTGCGGGACTTAACCCAACATCTCACGACACGAGCTG

ACGACAGCCATGCAGCACCTGTGTTCGAGTTCCCGAAGGCACCAATCCATCT
CTGGAAAGTTCTCGACATGTCAAGGCCAGGTAAGGTTCTTCGCGTTGCATCG
AATTAAACCACATACTCCACCGCTTGTGCGGGCCCCCGTCAATTCCTTTGAGT
TTCAGTCTTGCGACCGTACTCCCCAGGCGGCGAACTTAACGCGTTAGCTTCGA
TACTGCGTGCCAAATTGCACCCAACATCCAGTTCGCATCGTTTAGGGCGTGGA
CTACCAGGGTATCTAATCCTGTTTGCTCCCCACGCTTTCGTGCCTCAGTGTCA
GTGTTGGTCCAGGTAGCTGCCTTCGCCATGGATGTTCCTCCTGATCTCTACGC
ATTTCACTGCTACACCAGGAATTCCGCTACCCTCTACCACACTCTAGTCGTCC
AGTTTCCACTGCAGTTCCCAGGTTGAGCCCAGGGCTTTCACAACAGACTTAAA
CGACCACCTACGCACGCTTTACGCCCAGTAATTCCGAGTAACGCTTGCACCCT
TCGTATTACCGCGGCTGCTGGCACGAAGTTAGCCCGGTGCTTATTCTTTGGGT
ACCGTCATCACCAACCCGGGTATTAACCCAGCTGCATTTTCTTTCCCACAAAA

Strain NRCJ-53

ATACACCGTGGTAACCGTCCTCCCGAAGTTAAACTAGCTACTTCTGGTGCAAC
CCACTCCCATGGTGTGACGGGCGGTGTGTACAAGGCCCGGGAACGTATTCAC
CGCGACATTCTGATTCGCGATTACTAGCGATTCCGACTTCACGCAGTCCAGTT
GCAGACTGCGATCCGGACTACGATCGGTTTTGTGGGATTAGCTCCACCTCGCG
GCTTGGCAACCCTCTGTACCGACCATTGTAGCACGTGTGTAGCCCAGGCCGT
AAGGGCCATGATGACTTGACGTCATCCCCACCTTCCTCCGGTTTGTCACCGGC
AGTCTCCTTAAAGTGCCCACCTTAACGTGCTGGTAACTAAGGACAAGGGTTG
CGCTCGTTACGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAGCC
ATGCAGCACCTGTCTCAGTGTTCCCGAAGGCACCAAACCATCTCTGGTAAGTT
CACTGGATGTCAAGGCCTGGTAAGGTTCTTCGCGTTGCTTCCAATTAAACCAC
ATGCTCCACCGCTTGTGCGGGCCCCCGTCAATTCATTTGAGTTTTAACCTTGC
GGCCGTACTCCCCAGGCGGTCAACTTAATGCGTTAGCTGCGCCACTAAAATC
TCAAGGATTCCAACGGCTAGTTGACATCGTTTACAGCGTGGACTACCAGGGT
ATCTAATCCTGTTTGCTCCCCACGCTTTCGCACCTCAGTGTCAGTATGAGCCC
AGGTGGTCGCCCTTC

Strain NRCJ-54

GCAGCAGGCCTAACACATGCAAGTCGAGCGGATGAAGGGAGCTTGCTCCTGA
ATTCAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGG
ACAACGTTTCGAAAGGAACGCTAATACCGCATACGTCCTACGGGAGAAAGCA

GGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAGT
TGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGAT
GATCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCA
GTGGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGTG
TGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGTTGTA
GATTAATACTCTGCAATTTTGACGTTACCGACAGAATAAGCACCGGCTAACTC
TGTGCCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTACT
GGGCGTAAAGCGCGCGTAGGTGGTTCGTTAAGTTGGATGTGAAATCCCCGGG
CTCAACCTGGGAACTGCATCCAAAACTGGCGAGCTAGAGTATGGTAGAGGGT
GGTGGAATTTCCTGTGTAGCGGTGAAATGCGTAGATATAGGAAGGAACACCA
GTGGCGAAGGCGACCACCTGGACTGATACTGACACTGAGGTGCGAAAGCGTG
GGGAGCAAACAGGATTAGATACCCTGGTAGTCCACGCCGTAAACGATGTCAA
CTAGCCGTTGGGAGCCTTGAGCTCTTAGTGGCGCAGCTAACGCATTAAGTTG
ACCGCCTGGGGAGTACGGCCGCAAGGTTAAAACTCAAATGAATTGACGGGG
GCCCGCACAAGCGGTGGAGCATGTGGTTTAATTCGAAGCAACGCGAAGAACC
TTACCAGGCCTTGACATCCAATGAACTTTCCAGAGATGGATTGGTGCCTTTCG
GGAACATTGAGACAGGTGCTGCATGGCTGTCGTCAGCTCGTGTCGTGAGATG
TTGGGTTAAGTCC

Strain NRCJ-55

CGGCACCTGCGCGTGCTTAAACATGCAAGTTCGAACGATGATCAGGAGCTTG
CTCCTGTGATTAGTGGCGAACGGGTGAGTAACACGTGAGTAACCTGCCCCTG
ACTCTGGGATAAGCGTTGGAAACGACGTCTAATACTGGATATGATCACTGGC
CGCATGGTCTGGTGGTGGAAAGATTTTTTGGTTGGGGATGGACTCGCGGCCT
ATCAGCTTGTTGGTGAGGTAATGGCTCACCAAGGCGACGACGGGTAGCCGGC
CTGAGAGGGTGACCGGCCACACTGGGACTGACACACGGCCCACACTCCTACG
GGAGGCAGCAGTGGGGAATATTGCACAATGGGCGAAAGCCTGATGCAGCAA
CGCCGCGTGAGGGATGACGGCCTTCGGGTTGTAAACCTCTTTTAGTAGGGAA
GAAGCGAAAGTGACGGTACCTGCAGAAAAAGCACCGGCTAACTACGTGCCA
GCAGCCGCGGTAATACGTAGGGTGCAAGCGTTGTCCGGAATTATTGGGCGTA
AAGAGCTCGTAGGCGGTTTGTCGCGTCTGCTGTGAAATCCCGAGGCTCAACC
TCGGGCTTGCAGTGGGTACGGGCAGACTAGAGTGCGGTAGGGGAGATTGGA
ATTCCTGGTGTAGCGGTGGAATGCGCAGATATCAGGAGGAACACCGATGGCG
AAGGCAGATCTCTGGGCCGTAACTGACGCTGAGGAGCGAAAGCGTGGGGAG
CGAACAGGATTAGATACCCTGGTAGTCCACGCCGTAAACGTTGGGCGCTAGA

TGTAGGGACCTTTCCACGGTTTCTGTGTCGTAGCTAACGCATTAAGCGCCCCG
CCTGGGGAGTACGGCCGCGAGGCTAAAACTCAAAGGAATTGACGGGGGCCC
GCACAAGCGGCGGAGCATGCGGATTAATTCGATGCAACGCGAAGAACCTTAC
CAAGGCTTGACATACACCGGAAACGGCCAGAGATGGTCGCCCCCTTGTGGTC
GTGTACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTCGTGAGATGTTGGGTT
AAGTCCCGCAACGAGCGCAACCCCTCGTATCTATGTTAGCCAGCTGCGTTTAT
GGCTGGCACTCATAGGAGACTGCCCGGGTCCAGCTCGGAGCAGTGGGGATG
ACGGTCCAAATTCATCCATGGCCCTTTAGTTCCTGGCTTCACACGCCATGGGC
TTAACACTGGTGGCCG

Strain NRCJ-56

TTGAAATGCGCAGGCCTAACACACTGCAAGCTCGAGCGGATGACGGGAGCTT
TGCTCCTCTGATTCAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTG
GTAGTGGGGGACAACGTTTCGAAAGGAACGCTAATACCGCATACGTCCTACG
GGAGAAAGCAGGGGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGG
ATTAGCTAGTTGGTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGT
CTGAGAGGATGATCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACG
GGAGGCAGCAGTGGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCA
TGCCGCGTGTGTGAAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAG
GAAGGGCAGTAAGCTAATACCTTGCTGTTTTGACGTTACCGACAGAATAAGC
ACCGGCTAACTCTGTGCCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTA
ATCGGAATTACTGGGCGTAAAGCGCGCGTAGGTGGTTCGTTAAGTTGGATGT
GAAAGCCCCGGGCTCAACCTGGGAACTGCATCCAAAACTGGCGAGCTAGAGT
ACGGTAGAGGGTGGTGGAATTTCCTGTGTAGCGGTGAAATGCGTAGATATAG
GAAGGAACACCAGTGGCGAAGGCGACCACCTGGACTGATACTGACACTGAG
GTGCGAAAGCGTGGGGAGCAAACAGGATTAGATACCCTGGTAGTCCACGCCG
TAAACGATGTCAACTAGCCGTTGGAATCCTTGAGATTTTAGTGGCGCAGCTA
ACGCATTAAGTTGACCGCCTGGGGAGTACGGCCGCAAGGTTAAAACTCAAAT
GAATTGACGGGGGCCCGCACAAGCGGTGGAGCATGTGGTTTAATTCGAAGCA
ACGCGAAGAACCTTACCAGGCCTTGACATGCAGAGAACTTTCCAGAGATGGA
TTGGTGCCTTTCGGGAACTCTGACACAGGTGCTGCATGGCTGTCGTCAGCTCG
TGTCGTGAGATGTTGGGTTTAGGTCCCGTAACGAGCGCAACCCTTGTCCTAGT
TAACCAAGCACGTTATGGTGGGCACTCTAGAGACTGCAGTGACAACCCGGAG
GAGTTGGGATGACGTTCAGTCATCATGGACCTTACCGACCTGGGCCTTACAC
ACACGTGGACTC

Strain NRCJ-57

TCGAACGGTAACAAGGAAGAAGCTTGCTGCTTTGCTGACGAAGTGGCGGACG
GGTGAGTAATGTCTGGGAAACTGCCTGATGGAGGGGGATAACTACTGGAAAC
GGTAGCTAATACCGCATAACGTCGCAAGACCAAAGAGGGGGACCTTCGGGC
CTCTTGCCATCGGATGTGCCCAGATGGGATTAGCTTGTAGGTGGGGTAACGG
CTCACCTAGGCGACGATCCCTAGCTGGTCTGAGAGGATGACCAGCCACACTG
GAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGTGGGGAATATTGC
ACAATGGGCGCAAGCCTGATGCAGCCATGCCGCGTGTATGAAGAAGGCCTTC
GGGTTGTAAAGTACTTTCAGCGGGGAGGAAGGGAGTAAAGTTAATACCTTTG
CTCATTGACGTTACCCGCAGAAGAAGCACCGGCTAACTCCGTGCCAGCAGCC
GCGGTAATACGGAGGGTGCAAGCGTTAATCGGAATTACTGGGCGTAAAGCGC
ACGCAGGCGGTTTGTTAAGTCAGATGTGAAATCCCCGGGCTCAACCTGGGAA
CTGCATCTGATACTGGCAAGCTTGAGTCTCGTAGAGGGGGGTAGAATTCCAG
GTGTAGCGGTGAAATGCGTAGAGATCTGGAGGAATACCGGTGGCGAAGGCG
GCCCCCTGGACGAAGACTGACGCTCAGGTGCGAAAGCGTGGGGAGCAAACA
GGATTAGATACCCTGGTAGTCCACGCCGTAAACGATGTCGACTTGGAGGTTG
TGCCCTTGAGGCGTGGCTTCCGGAGCTAACGCGTTAAGTCGACCGCCTGGGG
AGTACGGCCGCAAGGTTAAAACTCAAATGAATTGACGGGGGCCCGCACAAG
CGGTGGAGCATGTGGTTTAATTCGATGCAACGCGAAGAACCTTACCTGGTCTT
GACATCCACGGAAGTTTTCAGAGATGAGAATGTGCCTTCGGGAACC

Strain NRCJ-58

AGGCCTAACACATGCAAGTCGAGCGGCAGCACGGGTACTTGTACCTGGTGGC
GAGCGGCGGACGGGTGAGTAATGCCTAGGAATCTGCCTGGTAGTGGGGGATA
ACGCTCGGAAACGGACGCTAATACCGCATACGTCCTACGGGAGAAAGCAGG
GGACCTTCGGGCCTTGCGCTATCAGATGAGCCTAGGTCGGATTAGCTAGTTG
GTGAGGTAATGGCTCACCAAGGCGACGATCCGTAACTGGTCTGAGAGGATGA
TCAGTCACACTGGAACTGAGACACGGTCCAGACTCCTACGGGAGGCAGCAGT
GGGGAATATTGGACAATGGGCGAAAGCCTGATCCAGCCATGCCGCGTGTGTG
AAGAAGGTCTTCGGATTGTAAAGCACTTTAAGTTGGGAGGAAGGGCATTTAC
CTAATACGTAAGTGTTTTGACGTTACCGACAGAATAAGCACCGGCTAACTCT
GTGCCAGCAGCCGCGGTAATACAGAGGGTGCAAGCGTTAATCGGAATTACTG
GGCGTAAAGCGCGCGTAGGTGGTTCGTTAAGTTGGATGTGAAATCCCCGGGC
TCAACCTGGGAACTGCATTCAAAACTGTCGAGCTAGAGTATGGTAGAGGGTG

GTGGAATTTCCTGTGTAGCGGTGAAATGCGTAGATATAGGAAGGAACACCAG
TGGCGAAGGCGACCACCTGGACTGATACTGACACTGAGGTGCGAAAGCGTGG
GGAGCAAACAGGGTTATATACCCTGGTAGTCCACGCCGTAAACAATGTCTAC
TAGCTCTCCGGAGCCAAGAAATTTTACTCGCGCAGCCTACCACATTCATTTGA
CCGATTGGTGGGGTGCGGTCCCGCGGGTGAAGACTCAGATTATTTTAATTTGA
GGCGAGCCCAACCCCAGGCGGCGGGAGTTTGTGCTTTAAATTCACAGCACGG
GCCGGACCCCTGCCTGGACCTCCGACAACCAATGAACGATACAGACACCGGA
TTTTTGTCTGTCAGGAAAATAAGAAAAAACATTACATCACAGACGAACACCC
CCTCTGCTGCCCTGGATATTGTTTGGGTTTAACCTCCCCCCCAACACGTCGCC
GAGCGC

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Date Received