

Table S1: Isolation of rare actinobacteria from different sources

Strain / Family	Pretreatment method	Isolation media (Agar)	References
Marine			
<i>Isoptericola</i> sp, <i>Rhodococcus</i> sp, <i>Nonomuraeae</i> sp, <i>Nocardiopsis</i> sp <i>Microbispora</i> sp, & <i>Microbacterium</i> sp	Washed with sterile sea water/ Incubated in acetyl trimethylammonium bromide (CTAB) buffer solution containing proteinase K	Starch-Casein-Nitrate (SCN), Raffinose-Histidine (RH), & Nutrient-Poor Sediment Extract (NPS)	1
<i>Micromonospora</i> sp <i>Rhodococcus</i> sp <i>Plantactinospira</i> sp <i>Nonomuraea</i> sp <i>Actinomadura</i> sp & <i>Streptosporangium</i> sp	Heated water bath 55°C	Humic acid-Vitamin (HV), SCN, Marine agar (MA), Poor Ravan saline agar (PRSA), Oligotrophic (OT), Starch-Modified Medium 1(SM1), Reasoner's 2A Agar (R2A), & Alkaliphiles Pirellula medium (M1)	2
<i>Micromonospora</i> sp, <i>Saccharopolyspora</i> sp, <i>Actinomadura</i> sp, <i>Actinopolymorpha</i> sp, <i>Nocardiopsis</i> sp, <i>Saccharomonospora</i> sp, <i>Stackebrandtia</i> sp & <i>Verrucosipora</i> sp	Sterile bags stored -20°C	M1, Alkaliphiles Pirellula medium (Medium 2) & Alkaliphiles Pirellula medium (Medium 3)	3
<i>Streptomycetaceae</i> , <i>Pseudonocardiaceae</i> , <i>Nocardiopsaceae</i> , <i>Nocardiaceae</i> , <i>Promicromonosporaceae</i> & <i>Micrococcaceae</i>	Heated 55 °C	Starch casein agar (SCA), International Streptomyces Project 2 (ISP2), Actinomycetes isolation agar (AIA), Streptomyces agar (SA), International Streptomyces Project 5 (ISP5), International Streptomyces Project 7 (ISP7), & Tap water yeast extract (TWYE)	4
<i>Micromonospora</i> sp, <i>Streptomyces</i> sp & <i>Actinomadura</i> sp	Dilution / Water bath 60°C	M3, NPS, & SCN	5
<i>Micromonospora</i> sp, <i>Nocardia</i> sp, <i>Actinoplanes</i> sp, <i>Nocardiopsis</i> sp <i>Saccharopolyspora</i> sp & <i>Crossiella</i> sp	Refrigerated 24 h / heat treatment 50°C water / irradiated by UV 254 nm / freeze dried	M1, M2, M3, M5	6
<i>Micromonospora</i> sp, <i>Nocardiopsis</i> sp <i>Rhodococcus</i> sp & <i>Saccharomonospora</i> sp,	Heated 120°C and incubated 55°C water bath / Shaken in a pH 7.0, 6% peptone and 0.05% SDS at 50°C / shaken and	Improved Gauze's 1, ISP2 SCA, Marine Agar 2216E (MA2216E), and M1	7

Strain / Family	Pretreatment method	Isolation media (Agar)	References
	treated with 20,000 Hz ultrasonic wave		
<i>Nocardiopsis dassonvillei</i>	Air dried one week / Dried 50°C	SCA	8
<i>Nocardiopsis</i> sp	Water bath 30°C	Starch nitrate agar (SNA)	9
<i>Streptomycetaceae, Micromonosporaceae, Gordoniaceae, Nocardiaceae, Thermomonosporaceae</i> and <i>Pseudonocardiaceae</i>	Dried at room temperature (RT), treated with 0.05% SDS, 6% yeast extract & 1.5% phenol & washed sterilized seawater	SNA, AIA, HV, & Chitin agar	10
<i>Microbacterium</i> sp, <i>Pseudonocardia</i> sp, <i>Streptomyces</i> sp, <i>Kocuria</i> sp, <i>Aeromicrobium</i> sp, <i>Brachybacterium</i> sp & <i>Nocardiopsis</i> sp	Washed with sea water and kept in 25% glycerol	YE, MA2216, ISP2, M1, R2A & RH	11
<i>Salinispora arenicola</i>	Not mentioned (nm)	Glucose Yeast-Malt Extract Agar (GYM), & Glucose Yeast Extract Agar (GYEA)	12
<i>Rhodococcus</i> sp	Heated 60°C	Zobell Marine Agar (ZMA) and Poor Ravan saline (PRS)	13
<i>Dermacoccus</i> sp & <i>Micrococcus luteus</i>	nm	MA	14
<i>Streptomyces</i> sp, & <i>Pseudonocardia</i> sp	Heated 50°C water bath	R2A	15
<i>Verrucosipora</i> sp	nm	ISP1	16
<i>Nocardiopsis</i> sp	Washed with agitation in sterile seawater	SCA and Nutrient agar (NA)	17
<i>Nocardiopsis</i> sp	nm	GYM agar	18
<i>Mumia</i> sp	Glass rod homogenized with sterile seawater	Artificial seawater agar (ASA)	19
<i>Streptomyces</i> sp & <i>Rhodococcus</i> sp	Airdried then 65°C heated	SCA, AIA, and International Streptomyces project-Bennett's agar medium.	20
<i>Salinispora</i> sp, <i>Nocardiopsis</i> sp, <i>Verrucosipora</i> sp, <i>Micromonospora</i> sp, <i>Prauserella</i> sp and <i>Promicromonospora</i> sp	nm	Bennett's Rich Medium (Br medium), Mannitol Peptone Glucose Medium (MPG), ISP2, Marine Medium 1 (MM1) & Humic Acid Medium (HM)	21
<i>Streptomyces</i> sp, <i>Blastococcus</i> sp, <i>Marinactinospora</i> sp, <i>Nocardiopsis</i> sp, <i>Agromyces</i> sp & <i>Nonomuraea</i> sp	Sample homogenized by vigorous vortexing, exposed to	M2, M3, & HVA	22

Strain / Family	Pretreatment method	Isolation media (Agar)	References
	UV irradiation and treated with skim milk/HEPES solution		
<i>Nocardiopsis</i> sp	Airdried and 50° C heated	SCA	23
<i>Actinomadura craniellae</i>	nm	Streptomyces isolation medium.	24
<i>Streptomycetaceae</i> sp, <i>Micromonosporaceae</i> sp, <i>Nocardiaceae</i> sp, & <i>Pseudonocardiaceae</i> sp	Laminar flow hood dried and 55°C heated	SCN, Glycerol arginine agar (GAA) & Chitin agar (CA)	25
<i>Nonomuraea</i> sp	nm	ISP2, & HV	26
<i>Actinomadura</i> sp	nm	nm	27
<i>Marmoricola</i> sp	nm	nm	28
Terrestrial soil			
<i>Microbacterium</i> sp	Airdried and CaCO ₃ treated	AIA, SCA, Glycerol Asparagine Agar (GSA), Yeast Malt Agar (YMA)/ISP2 and Bennet's agar.	29
<i>Nonomuraea</i> sp	4°C stored, added Ringer's solution and 60°C heated	Czapek–Dox agar (CDA)	30
<i>Nocardiopsis</i> sp	nm	SCA	31
<i>Actinomadura rubrisoli</i>	4°C stored, added Ringer's solution and 60°C heated	CDA	32
<i>Actinokineospora</i> sp	nm	Soil extract medium	33
<i>Nocardiopsis</i> sp, <i>Saccharopolyspora</i> sp, <i>Actinomadura</i> sp, <i>Actinocorallia</i> sp, <i>Micromonospora</i> sp, <i>Couchioplana</i> sp & <i>Planomonospora</i> sp	Airdried RT	SCA and HV	34
<i>Brachybacterium</i> sp, <i>Kineococcus</i> sp & <i>Microbacterium</i> sp	Laminar flow hood Air dried	M1-M11	35
<i>Nocardia</i> sp	80°C heated	ISP2 agar Incubated at 28°C for 7 days	36
<i>Nonomuraea</i> sp	60°C heated	Medium 5336	37
<i>Amycolatopsis</i> sp	60°C heated	Medium 5336	38
<i>Streptomonospora</i> sp	nm	SCA	39
<i>Streptomonospora litoralis</i>	nm	SCA	40
<i>Agromyces</i> sp, <i>Kocuria</i> sp & <i>Nesterenkonia</i> sp	Laminar flow hood airdried RT	M1, M2 (ISP 2 medium), M3 (R2A medium), M4 (Modified Cellulose-Casein medium),	41

Strain / Family	Pretreatment method	Isolation media (Agar)	References
		M5 (CMKA medium), M6 (Raffinose-Histidine medium), M7 (Trehalose-Proline medium), M8 (Proline medium) & M10 (CaseinGlucose medium)	
<i>Amycolatopsis taiwanensis</i>	nm	Humic-Vitamin-Yeast Medium (HVY)	42
<i>Micromonospora</i> sp <i>Actinokineospora</i> sp	28°C incubator air dried	GYM4 and (Zhang's Starch Soil Extract Agar) ZSSE	43
<i>Nocardia</i> sp	nm	AIA and (Glucose-L-Asparagine Medium) GLM	44
Mangrove			
<i>Mycobacterium saopaulense</i>	nm	ISP2	45
<i>Streptomyces</i> sp, <i>Rhodococcus</i> sp, <i>Microbacterium</i> sp <i>Micromonospora</i> sp, <i>Actinoplanes</i> sp & <i>Mycobacterium</i> sp	Dry heat 120 °C & phenol 1.5%	ISP 2, CDA, ISP4, NA, & Halothiobacillus HL2	46
<i>Brevibacterium</i> sp, <i>Curtobacterium</i> sp, <i>Kineococcus</i> sp, <i>Micromonospora</i> sp and <i>Mycobacterium</i> sp	Tween-20, NaClO, NaS ₂ O ₃ , ethanol, & NaHCO ₃	ISP2, ISP4, Gauze No. 1, NA Halothiobacillus HL2, CDA, & ISP7	47
<i>Nocardiosis</i> sp	Air dried 35°C	ISP2	48
<i>Streptomyces</i> sp, <i>Microbacterium</i> sp, <i>Agromyces</i> sp & <i>Rhodococcus</i> sp	Air-dried room temperature	M1-10	49

<i>Streptomyces</i> sp, <i>Curtobacterium</i> sp, <i>Mycobacterium</i> sp, <i>Micrococcus</i> sp, <i>Brevibacterium</i> sp, <i>Kocuria</i> sp, <i>Nocardioides</i> sp, <i>Kineococcus</i> sp, <i>Kytococcus</i> sp, <i>Marmoricola</i> sp, <i>Microbacterium</i> sp, <i>Micromonospora</i> sp <i>Actinoplanes</i> sp, <i>Agrococcus</i> sp, <i>Amnibacterium</i> sp, <i>Brachybacterium</i> sp, <i>Citricoccus</i> sp, <i>Dermacoccus</i> sp, <i>Glutamicibacter</i> sp, <i>Gordonia</i> sp, <i>Isopterica</i> sp, <i>Janibacter</i> sp, <i>Leucobacter</i> sp, <i>Nocardia</i> sp, <i>Nocardiosis</i> sp, <i>Pseudokineococcus</i> sp, <i>Sanguibacter</i> sp & <i>Verrucosipora</i> sp	Air dried and then ultrasonic washed	HV, ISP2, Yunnan Institute of Microbiology Medium 38 (YIM38), R2A, ISP3, RH, TWYE, GA & TP	50
<i>Micromonospora</i> sp	Heated 120°C, then treated with 1.5% phenol & moist heating with sterilized mangrove water	ISP1-7	51
<i>Saccharomonospora oceani</i>	Air-dried & CaCO ₃ treated	HV	52
<i>Streptomyces</i> sp, <i>Nocardiosis</i> sp & <i>Nocardioides</i> sp	Dried 50°C	SCA	53
<i>Nocardiosis</i> sp	Dried 35°C	ISP2	48
<i>Micromonospora</i> sp	Air-dried	M6, M8, HV & glucose–tryptone agar medium (GP)	54
<i>Nocardia</i> sp	nm	A1 Medium Control (TM)	55
<i>Micromonospora</i> sp, <i>Actinomadura</i> sp, <i>Rhodococcus</i> sp, <i>Nocardia</i> sp, & <i>Mycobacterium</i> sp	Air-dried	M1, M2, M4-8	56
<i>M. saopaulense</i>	Tween-20, NaClO, Na ₂ S ₂ O ₃ , ethanol, & NaHCO ₃ treated	ISP2, ISP4, Gauze No. 1, NA, Halothiobacillus HL2 & CDA	45
Rivers			
<i>Microbispora</i> sp, <i>Leifsonia</i> sp, <i>Verrucosipora</i> sp, & <i>Streptomyces</i> sp	nm	SCA	57
<i>Nocardiosis</i> sp, <i>Saccharopolyspora</i> sp, <i>Rhodococcus</i> sp, <i>Prauserella</i> sp, <i>Amycolatopsis</i> sp, <i>Promicromonospora</i> sp, <i>Kocuria</i> sp, <i>Micrococcus</i> sp, <i>Kocuria</i> sp & <i>Micrococcus</i> sp	55°C heated	SCA, ISP2, AIA, SA, ISP5, ISP7 & TWYE	4
Antarctic & arctic			
<i>Microbacterium</i> sp, <i>Rhodococcus</i> sp, & <i>Pseudonocardia</i> sp	nm	A1 agar	58

<i>Actinoplanes</i> sp, <i>Arthrobacter</i> sp, <i>Kribbella</i> sp, <i>Mycobacterium</i> sp, <i>Nocardia</i> sp, <i>Pilimelia</i> sp, <i>Pseudarthrobacter</i> sp, <i>Rhodococcus</i> sp, <i>Streptacidiphilus</i> sp, <i>Streptomyces</i> sp, & <i>Tsukamurella</i> sp	nm	SCA, HVA, Yeast Extract Malt Extract Agar (YEME) & Bacto-Yeast Extract	59
Hot springs			
<i>Micromonospora</i> sp and <i>Actinomadura</i> sp	Heated 50° C water bath	ISP1-6, SCA, R2A & Bushnell–Haas (BH)	60

nm; not mentioned

Starch-Casein-Nitrate agar (SCN): 10.0 g of soluble starch, 0.3 g of casein, 2 g of K₂ HPO₄, 2 g of KNO₃, 2 g of NaCl, 0.05 g of MgSO₄.7H₂O, 0.02 g of CaCO₃, 0.01 g of FeSO₄.7H₂O, and 17.0 g of agar, per liter of distilled water.

Raffinose-Histidine agar (RH): 10 g of raffinose, 1.0 g of L-Histidine, 1 g of K₂HPO₄, 0.5 g of MgSO₄.7H₂O, 0.01 g of FeSO₄.7H₂O, and 17.0 g of agar, per liter of distilled water.

Nutrient-Poor Sediment Extract agar (NPS): 100 mL of marine sediment extract obtained by washing 900 mL of sediments with 500 mL of seawater and 17.0 g of agar, per liter of seawater).

Humic acid-vitamin agar (HV): (Humic acid: (1.00 g); Na₂ HPO₄ (0.50 g); KCl (1.70 g); CaCO₃ (0.02 g); FeSO₄ (0.01 g); 0.00005% each of thiamine HCl, riboflavin, niacin, pyridoxine–HCl, inositol, Ca-pantothenate, p-aminobenzoic acid, and 0.000025% of biotin; Agar (18.00 g); Distilled water (1000.00 ml); pH 6.0).

Marine agar (MA): Peptone 5.0g Yeast extract 1.000g Ferric citrate 0.1 g Sodium chloride 19.450 g Magnesium chloride 8.80 g Sodium sulphate 3.240g Calcium chloride 1.80 g Potassium chloride 0.550 g Sodium bicarbonate 0.160 g Potassium bromide 0.080 g Strontium chloride 0.034 g Boric acid 0.022 g Sodium silicate 0.004 g Sodium fluorate 0.003 g Ammonium nitrate 0.002 g Disodium phosphate 0.008 g.

Poor Ravan saline agar (PRSA): (0.050g Peptone, 0.050 g Yeast extract 0.050 Sodium acetate 0.050 g Sodium citrate 0.050 g Pyruvic acid 0.050 g) & 15.0 g agar.

Oligotrophic agar (OT): (peptone 1 g, yeast extracts 0.5 g, K₂HPO₄.H₂O 1 g, MgSO₄.7H₂O 0.5 g, CaCO₃ 0.3 g, NaCl 5 g, vitamin mixtures, agar 15 g, pH 7.5).

SM1 agar: yeast nitrogen base (67.0 g; Difco) and casamino acids (100 mg; Difco), dipotassium hydrogen phosphate (200 ml), D (-) sorbitol.

SM2 agar: Yeast nitrogen base (67.0 g; Difco) and casamino acids (100 mg; Difco), dipotassium hydrogen phosphate (200 ml), D (+) melezitose.

SM3 agar: Gauze's medium 2 (glucose, 10 g; peptone, 5 g; tryptone, 3 g; NaCl, 5 g; agar, 15 g; distilled water, 1 l; pH 7.0.

R2A agar: contains 0.5 g of yeast extract, 0.5 g of Difco Proteose Peptone no. 3 (Difco Laboratories), 0.5 g of Casamino Acids (Difco), 0.5 g of glucose, 0.5 g of soluble starch, 0.3 g of K₂HPO₄, 0.05 g of MgSO₄ .7H₂O, 0.3 g of sodium pyruvate, and 15 g of agar per liter of laboratory quality water. Adjust the pH to 7.2 with crystalline K₂HPO₄ or KH₂PO₄.

M1 agar: Casein 0.3 g, Starch 10.0 g, KNO₃ 2.0 g, MgSO₄.7H₂O 0.05 g, K₂HPO₄ 0.5 g, CaCO₃ 0.02 g, FeSO₄.7H₂O 0.01 g, Agar 20.0 g, Distilled water 1.0 L, pH 8.0.

ISP 2 broth: Yeast Extract 4.0 g, Malt Extract 10.0 g, & Dextrose 4.0 g.

ISP1: Pancreatic Digest of Casein 5.0 g & Yeast Extract 3.0 g.

Actinomycetes isolation agar (AIA): Sodium caseinate 2.0g, L-Asparagine 0.1g, Sodium propionate 4.0g, Dipotassium phosphate 0.5g, Magnesium sulphate 0.1g, Ferrous sulphate 0.001g & Agar 15.0g.

Glycerol– asparagine agar (ISP5): L-Asparagine 1.0g, Yeast extract 4.0g, Dextrose 4.0g, Calcium carbonate 2.0g, and Agar 12.0g.

Tyrosine agar medium (ISP7): L-Asparagine 1.0g, L-Tyrosine 0.5g, Dipotassium hydrogen phosphate 0.5g, Magnesium sulphate heptahydrate 0.5g, Sodium chloride 0.5g, *Trace salt solution (ml) 1.0g, Agar 20.0g, *Trace salt solution contains - Ferrous sulphate heptahydrate 1.360mg Copper chloride, 2H₂O 0.027mg Cobalt chloride, 6H₂O, 0.040mg Sodium molybdate, dihydrate 0.025mg Zinc chloride, 0.020mg Boric acid 2.850mg Manganese chloride, tetrahydrate 1.80mg Sodium tartarate 1.770mg Final pH (at 25°C) 7.3±0.1.

Tap water yeast extract agar (TWYE): Peptic digest of animal tissue 5.0g Yeast extract 3.0g Agar 15.0g Final pH (at 25°C) 7.2±0.2.

M2: (0.5% peptone, 0.1% yeast extract, 0.08% MgCl₂, 0.6% CaCl₂, 1.5% agar in filtered seawater).

M3 agar: (per liter of distilled water): 0.466 g of KH₂PO₄, 0.732 g of Na₂HPO₄, 0.10 g of KNO₃, 0.29 g of NaCl, 0.10 g of MgSO₄·7H₂O, 0.02 g of CaCO₃, 200 µg of FeSO₄·7H₂O, 180 µg of ZnSO₄·7H₂O, 15 µg of MnSO₄·4H₂O, 4 mg of thiamine HCl (Vitamin B1) and 17 g of agar.

M4: (0.5% glucose, 0.1% asparagine, 0.1% K₂HPO₄, 1.8% agar in filtered seawater).

M5: (1.8% agar in filtered seawater) M6 (0.5% glycerol, 0.1% arginine, 0.1% K₂ HPO₄, 1.8% agar in filtered seawater).

Improved Gauze's 1 medium: Soluble starch 20 g; KNO₃, 1 g; K₂HPO₄·3H₂O 0.5 g; MgSO₄·7H₂O 0.5 g; NaCl, 0.5 g; FeSO₄·7H₂O 0.01 g; agar, 18 g; seawater 1 L; pH 7.4–7.6 Sodium Sulfate 3.24 g, Calcium Chloride 1.8 g, Potassium Chloride 0.55 g, Sodium Bicarbonate 0.16 g, Potassium Bromide 0.08 g, Strontium Chloride 34.0 mg, Boric Acid 22.0 mg, Sodium Silicate 4.0 mg, Sodium, Fluoride 2.4 mg, Ammonium Nitrate 1.6 mg, Disodium Phosphate 8.0 mg & Agar 15.0 g.

Marine agar 2216E: (Peptone 5.0 g, Yeast Extract 1.0 g, Ferric Citrate 0.1 g, Sodium Chloride 19.45 g, Magnesium Chloride 8.8 g.

Trehalose dehydrates proline: Trehalose 5 g; proline 1 g; (NH₄)₂SO₄ 1 g; NaCl 1 g; CaCl₂ 2 g; K₂HPO₄ 1 g; MgSO₄·7H₂O 1 g; Multi-vitamins: Vitamin B1, ribofavin, niacin, vitamin B6, calcium pantothenate, inositol, p-aminobenzoic acid 0.5 mg each; biotin 0.25 mg); agar 18 g; seawater 1 L; pH 7.2.

Medium: starch 40.0 g; glucose 0.5 g; peptone 5.0 g; soybean powder 5.0 g; CaCO₃ 1.0 g; K₂HPO₄, 0.5 g; MgSO₄, 0.5 g; agar 10.0 g; distilled water 1 L; pH 7.0–7.2).

Starch nitrate agar: 20.0 g L⁻¹ starch, 2.0 g L⁻¹ KNO₃, 1.0 g L⁻¹ K₂HPO₄, 0.5 g L⁻¹ MgSO₄·7H₂O, 0.5 g L⁻¹ NaCl, 0.01 g L⁻¹ FeSO₄·7H₂O, 3.0 g L⁻¹ CaCO₃, 20.0 g L⁻¹ agar and 1000 mL of 50% sea water), pH 7.2.

Modified rice medium composition: 100 g commercial rice and 100 mL 50% sea water containing 0.4% yeast extract and 1% malt extract.

Basal medium: 60 g NaCl, 8.36 g MgCl₂·6H₂O, 6.8 g MgSO₄·7H₂O, 0.66 g KCl, 0.5 g NH₄Cl, 0.212 g C

Chitin agar: Na₂HPO₄, 6; KH₂PO₄, 3; NH₄Cl, 1; NaCl, 0.5; yeast extract, 0.05; agar, 15 and colloidal chitin 1% (w/v). aCl₂, 15 g agar in 1 liter distilled water, pH 7.5.

Starch-yeast extract: 1% (w/v) starch, 0.4% (w/v) yeast extract, 0.2%, (w/v) peptone, 3.33% (w/v) artificial sea salts - Instant Ocean Brand, 1.5% (w/v) agar.

Modified soil extract agar: Meat extracts 3 g, peptone 5 g, salt mixtures*, agar 25 g, pH 7.2–7.5.

YE Agar: Peptic digest of animal tissue 5.0g, Yeast extract 3.0g, & Agar 15.0g Final pH 7.2 +/- 0.2 at 25°C.

GYES (Glucose Yeast Extract Agar): Peptone 5.0g, Yeast extract 5.0g, Dextrose (Glucose) 2.0g, Potassium dihydrogen phosphate 0.5g, Dipotassium hydrogen phosphate 0.5g, Magnesium sulphate 0.3g, Sodium chloride 0.010g, Manganese sulphate 0.010g, Zinc sulphate 0.0016g, Copper sulphate 0.0016g, Copper sulphate 0.0016g, Cobalt sulphate 0.0016g & Agar 15.0g.

GYM (Glucose Yeast Extract-Malt Extract Agar, DSMZ-Medium 65): Glucose 4.0 g, Yeast extract 4.0 g, Malt extract 10.0 g, CaCO₃ 2.0 g, Agar 12.0 g and Distilled water 1000.0 ml.

Poor Ravan saline: Glucose 0.05g, Peptone, 0.05g, Yeast extract 0.05g, Sodium acetate 0.05g, Sodium citrate 0.05g, Pyruvic acid 0.05g.

Sponge agar: (1% macerated sponge colonies collected from the site, 50% sea water and 2.5% agar).

Sea Water Agar: (50% sea water and 2.5% agar).

Modified Sabouraud glucose agar: (SGA; 7.5 g casamino acid, 10.0 g yeast extract, 20.0 g MgSO₄·7H₂O, 3.0 g trisodium citrate·2H₂O, 2.0 g KCl, 34.0 g NaCl, 10.0 µg Fe²⁺, 18.0 g agar, 1.0 l distilled water, pH adjusted to 7.4).

Nutrient agar (NA): Peptone 5.0g, Sodium chloride 5.0g, HM peptone, 1.5g & Yeast extract 1.5g & Agar Artificial seawater agar: plate containing 0.1% pyruvate, 0.05% catechin 15.0g Final pH (at 25°C).

SPY medium: with 2 mM LaCl₃ (soluble starch 20 g, glucose 10 g, peptone 5 g, yeast extract 5 g, K₂HPO₄ 0.5 g, MgSO₄·7H₂O 0.5 g, CaCO₃ 2 g, and sea salt 39.5 g, per liter).

Soybean meal medium: (3.3% soybean meal, 2.2% soluble starch, 2.2% glycerol, 1.2% meat extract, 2.0% peptone, and 2.2% CaCO₃), starch medium (2.4% starch, 0.1% glucose, 0.5% peptone, 0.5% yeast extract, 0.3% meat extract, and 0.4% CaCO₃), pharmamedia medium (1.0% pharmamedia, 0.5% glucose, 0.5% corn steep powder, 1.0% oatmeal, 0.5% K₂HPO₄, 0.5% MgSO₄·7H₂O) and 1mL/L trace metals solution (0.1% FeSO₄·7H₂O, 0.1% MnCl₂·4H₂O, 0.1% ZnSO₄·7H₂O, 0.1% CuSO₄·5H₂O and 0.1% CoCl₂·6H₂O) and defatted wheat germ medium (1.0% defatted wheat germ, 2.0% soluble starch, 0.5% glycerol, 0.3% meat extract, 0.3%, dry yeast, and 0.3% CaCO₃).

Sabouraud dextrose broth: Dextrose (Glucose) 20.0g Peptone, special 10.0g Final pH (at 25°C) 5.6±0.2.

MM1: containing 6.56 g KH₂PO₄, 30.96 g Na₂HPO₄, 0.41 g MgSO₄·7 H₂O, 0.088 g ferric citrate, 10 g glucose, 0.1 g L-leucine, 0.1 g L-isoleucine, 0.1 g L-valine, 0.1 g L-methionine, 0.1 g L-arginine, 0.1 g L-cysteine, 0.1 g L-glutamine, 0.5 mg riboflavin, 1 mg thiamin, 0.5 mg D-biotin, and 0.005 mg alpha -lipoic acid.

M001: Peptone 5.0g, Sodium chloride 5.0g, HM peptone B# 1.5g, Yeast extract 1.5g, & Agar 15.0g. Final pH (at 25°C) 7.4±0.2. Streptomyces isolation medium: containing 3 % sea salt.

Glycerol arginine agar (GAA): glycerol 10 g, asparagine 1 g, K₂HPO₄·H₂O 1 g, MgSO₄·7H₂O 0.5 g, CaCO₃ 0.3 g, vitamin mixture of HV medium 3.7 mg, and agar 15 g, pH 7.2.

A-16 production medium: consisting of glucose 2%, Pharmamedia (Trader's Protein) 1%, CaCO₃ 0.5%, Corporation, 50 g l⁻¹).

Bn-2 agar medium: (soluble starch 0.5%, glucose 0.5%, meat extract (Kyokuto Pharmaceutical Industrial Co., Ltd.) 0.1%, yeast extract (Difco Laboratories) 0.1%, NZ-case (Wako Chemicals USA, Inc.) 0.2%, NaCl 0.2%, CaCO₃ 0.1%, and agar 1.5% in distilled water of pH 7.0).

A11M production medium: (glucose 0.2%, soluble starch 2.5%, yeast extract 0.5%, polypeptone (Wako Pure Chemical Industries, Ltd.) 0.5%, NZ-amine (Wako Pure Chemical Industries, Ltd.) 0.5%, CaCO₃ 0.5%, and Diaion® HP-20 1% in distilled water of pH 7.0).

Basal medium: 60 g NaCl, 8.36 g MgCl₂·6H₂O, 6.8 g MgSO₄·7H₂O, 0.66 g KCl, 0.5 g NH₄Cl, 0.212 g CaCl₂, 15 g agar in 1 liter distilled water, pH 7.5.

Czapek–Dox agar: Sucrose 20 g, NaNO₃ 2 g, K₂HPO₄ 1 g, MgSO₄·7H₂O 0.5 g, KCl 0.5 g, FeSO₄·7H₂O 0.01 g, vitamin mixtures 3.7 mg, agar 25 g, pH 7.2.

Soil extract medium: Meat extracts 3 g, peptone 5 g, salt mixtures*, agar 25 g, pH 7.2–7.5.

TSB (trypticase soy broth): Pancreatic digest of casein: 1.7g, Papaic digest of soybean meal: 0.3g, Sodium chloride (NaCl): 0.5g, Dibasic potassium phosphate (K₂HPO₄): 0.25g, Glucose monohydrate: 0.25g in 100 ml distilled water pH after sterilization (at 25°C): 7.3±0.2.

M6 media: Raffinose 5.0 g, Histidine 1.0 g, KNO₃ 1.0 g, NaCl 1.0 g, CaCl₂ 2.0 g, K₂HPO₄ 1.0 g, MgSO₄·7H₂O 1.0 g, Trace salt 1.0 mL, Agar 20.0 g, Distilled water 1.0 L, pH 8.0.

M7 media: Trehalose 5.0 g, L-Proline 1.0 g, (NH₄)₂SO₄ 1.0 g, CaCl₂ 2.0 g, NaCl 1.0 g, K₂HPO₄ 1.0 g, MgSO₄·7H₂O 1.0 g, Vitamin mixture 1.0 mL, Agar 20.0 g, Distilled water 1.0 L, pH 8.0.

M8: Glucose 1.0 g, peptone 0.5 g, tryptone 0.3 g, NaCl 30.5 g, Vitamin mixture 1.0 mL, Agar 20.0 g, Distilled water 1.0 L, pH 8.0.

M9 media: Glucose 1.0 g, peptone 0.5 g, tryptone 0.3 g, NaCl 0.5 g, Vitamin mixture 1.0 mL, Agar 20.0 g, Distilled water 1.0 L, pH 8.0.

M10: R2A 18.6 g (BD), NaCl 30.0 g, Agar 12.0 g, H₂O 1.0 L, pH 8.0.

M11 media: Chitin 2.0 g, K₂HPO₄ 0.7 g, KH₂PO₄ 0.3 g, MgSO₄·7H₂O 0.5 g, FeSO₄·7H₂O 0.01 g, ZnSO₄ 0.001g, MnCl₂ 0.001g, Agar 12.0 g, Distilled water 1.0 L, pH 8.0.

Medium 5336: (soluble starch (10 g/L), casein (peptone Typ M) (1 g/L), K₂HPO₄ (0.5 g/L), MgSO₄·7H₂O (5.0 g/L), and agar (20 g/L). **Medium:** composed of 15 g of glucose, 15 g of soybean meal, 5 g of corn steep liquor, 2 g of CaCO₃ and 5 g of NaCl in 1 L distilled water, pH was adjusted to 7.0.

Medium 5294: (1% soluble starch, 0.2% yeast extract, 1% glucose, 1% glycerol, 0.25% corn steep liquor, 0.2% peptone, 0.1% NaCl, 0.3% CaCO₃; pH 7.2

GYM4 media: Composed of 4 g each of glucose, yeast extract and malt extract per litre of demineralized water. **ZSSE agar media:** Containing starch and soil extract.

GLM agar media: Yeast extract, 3 g; malt extract, 3 g; peptone Type I, 5 g; starch, 10 g; agar, 20 g; distilled water, 1000 mL.

ISP 4: Soluble Starch 10g/L, Dipotassium Phosphate 1g/L, Magnesium Sulfate USP 1g/L, Sodium Chloride 1g/L, Ammonium Sulfate 2g/L, Calcium Carbonate 2g/L, Ferrous Sulfate 1mg/L, Manganous Chloride 1mg/L, Zinc Sulfate 1mg/L, Agar 20g/L.

Gauze No.1: (soluble starch, 20.0 g; ferrous sulfate, 0.01 g; sodium chloride, 0.5 g; potassium nitrate, 1.0 g; magnesium sulfate, 0.5 g; dipotassium hydrogen phosphate, 0.5 g; agar, 15.0 g; distilled water 1 L, pH 7.2).

Nutrient agar: Peptone, 10.0 g; sodium chloride, 5.0 g; beef extract, 3.0 g; agar, 15.0 g; distilled water 1 L, pH 7.2).

Halothiobacillus HL2 medium: Glucose, 10.0 g; tryptone, 3.0 g; peptone, 5.0 g; NaCl, 5.0 g; agar, 20.0 g; distilled water 1 L, pH 7.2). Czapek agar.

ISP 7: L-Asparagine 1.0g L-Tyrosine 0.5g Dipotassium hydrogen phosphate 0.5g Magnesium sulphate heptahydrate 0.5g Sodium chloride 0.5g *Trace salt solution (ml) 1.0g Agar 20.0g.

YIM 38 broth medium: yeast extracts 4 g; glucose 4 g; malt extracts 10 g; thiamine-HCl, riboflavin, niacin, pyridoxin-HCl, inositol, calcium pantothenate, paminobenzoic acid, each 0.5 mg, and biotin 0.25 mg; pH 7.2.

TWYE: Yeast extract (0.25 g); K₂HPO₄ (0.50 g); Agar (18.0 g); Tap water (1000.00 ml).

TP agar: Trehalose (5.0 g); proline (1.0 g); (NH₄)₂SO₄ (1.0 g); NaCl (1.0 g); CaCl₂ (2.00 g); K₂HPO₄ (1.0 g); MgSO₄·7H₂O (1.00 g); Agar (20.0 g); vitamin mixture (1.00 ml), Distilled water (1000.00 ml); pH 7.2.

CM: Microcrystalline cellulose (10.0 g); Casein (0.30 g); KNO₃ (0.20 g); K₂ HPO₄ (0.50 g); CaCO₃ (0.02 g); FeSO₄ (0.01 g); NaCl (100 g); MgCl₂·6H₂O (30 g), KCl (20 g); Agar (15.0 g); Distilled water (1000.0 ml); pH 7.5.

GA agar: Soluble starch (20.0 g); KNO₃ (1.0 g); K₂HPO₄ (0.50 g); MgSO₄·7H₂O (0.05 g); FeSO₄·7H₂O (0.01 g); Agar (20.0 g); Distilled water (1000.0 ml); pH 7.4-7.6.

GP (glucose-tryptone agar medium): Casein enzymic hydrolysate, 5.0g, Yeast extract, 3.0g, Glucose, 1.0g & Agar, 15.0g in 1sliter deionized water.

A1 Medium: Control (TM), where the sediment was amended with 1 L of A1 medium (1 L mangrove filtered water, 2 g peptone, 10 g starch, 4 g yeast extract.

Modified 2216 medium broth: soybean cake (20 g), maltodextrin (10 g), peptone (5.0 g), yeast extract (10 g), glucose (10 g), NaCl (19.45 g), MgCl₂·6H₂O (12.6 g), MgSO₄·7H₂O (6.64 g), CaCl₂ (1.8 g), KCl (8.0 mg), SrCl₂·6H₂O (57 mg), and ferric citrate (0.1 g).

SG broth: Glucose 20.0 g, yeast extract 5.0 g, Soytone 10 g, CoCl₂·6H₂O (1.0 mg) and calcium carbonate 2.0 g in 1 liter of demineralized water. The suspension (pH 7.2).

GLM medium: Yeast extract, 3.0g, malt extract 3.0g, peptone 5.0g, glucose: 10.0g (pH- 7.2).

CYSP medium: Casein hydrolysate 10.0g, starch 10.0g, yeast extract 1.0g, peptone 1.0g, (pH- 7.2).

MGYP medium: Maltose 3.0g, glucose: 10.0g, yeast extract 3.0, peptone 5.0g, (pH- 7.2).

Medium 333: Glucose 5.0g, peptone 3.0g, soluble starch 10.0g, yeast extract 3.0g, CaCO₃ 2.0g, NH₄NO₃ 3.0g, (pH- 7.2).

A 1 agar: starch, 10 g l-1; yeast extract, 4 g l-1; peptone, 2 g l-1; agar, 14 g l-1),

SW agar: (agar, 14 g l-1).

SC agar: starch, 10 g l-1; KNO₃, 2 g l-1; K₂ HPO₄, 2 g l-1; casein, 0.3 g l-1; MgSO₄ ·7H₂O, 0.05 g l-1; CaCO₃, 0.02 g l-1; FeSO₄ ·7H₂O, 0.01 g l-1; agar, 18 g l-1.

Yeast Extract Malt Extract Agar (YEME): Bacto-Yeast Extract (Difco) 4.0g, Bacto-Malt Extract (Difco) 10.0 g, Bacto-Dextrose (Difco) 4.0 g, & i Bacto agar 20.0g in 1000 ml Distilled water.

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