CLAIMS

1. A method of colonizing a nasal cavity of a subject, comprising:

administering an effective amount of a preparation comprising ammonia oxidizing microorganisms ("AOM") to the nasal cavity of the subject,

wherein the AOM colonize a target tissue of the nasal cavity.

2. Use of AOM in the manufacture of a preparation for treating neurogenic inflammation, e.g., oxidative stress, in a subject, wherein an effective amount of the preparation is to be administered to the subject.

3. Use of AOM in the manufacture of a preparation for treating a neurological disorder in a subject, wherein an effective amount of the preparation is to be administered to the subject.

4. Use of AOM in the manufacture of a preparation for treating a nasal or sinus disorder in a subject, wherein an effective amount of the preparation is to be administered to the subject.

5. Use of AOM in the manufacture of a preparation for treating a systemic inflammatory condition in a subject, wherein an effective amount of the preparation is to be intranasally administered to the subject.

6. The use of claim 5, wherein the systemic inflammatory condition is associated with one or more of: headaches (e.g., migraines), cardiovascular diseases (e.g., hypertension), inflammation, immune responses, autoimmune disorders, liver diseases, infections, neurological diseases, psychiatric disorders, nitric oxide disorders, urea cycle disorders, congestion, vasodilation disorders, skin diseases, wound healing, reactions to insect bites, ophthalmic disorders, connective tissue disorders, and certain viral, bacterial, or fungal infections.

7. Use of AOM in the manufacture of a preparation for treating a headache or migraine headache in a subject, wherein an effective amount of the preparation is to be intranasally administered to the subject.

8. The use of any of claims 2-7, wherein the preparation is to be administered in an amount and/or at a frequency sufficient to increase mucus thickness in at least a portion of the nasal cavity of the subject.

9. The use of any of claims 2-8, wherein the preparation anti-triggers ischemic pre-conditioning or modulates an ATP level in the subject.

10. The use of any of claims 2-9, wherein the preparation is to be administered in an amount and/or at a frequency sufficient to induce ischemic anti-triggering in the subject.

11. The use of any of claims 2-10, wherein the preparation is to be administered intranasally to a nasal cavity of the subject.

12. The use of any of claims 2-11, wherein the nasal cavity of the subject is substantially cleared when the preparation is to be administered.

13. The use of any of claims 2-12, wherein the preparation is to be administered subsequent to an antibiotic or a nasal cavity cleansing preparation.

14. The use of any of claims 2-13, wherein a target percentage of AOM is to be transferred to a central nervous system (CNS) of the subject.

15. The use of any of claims 2-14, wherein water or a buffer solution, e.g., an aqueous buffer solution, is to be further administered to the subject subsequent to the preparation.

16. The use of any of claims 2-15, wherein the preparation results in decongestion, decreased sinus pressure, or modulation of an inflammatory response.

17. The use of claims 3, wherein the neurological disorder is an inflammatory condition.

18. The use of claims 5, wherein the inflammatory condition is a nasal or sinus disorder.

19. The use of claim 18, wherein the nasal or sinus disorder is allergic rhinitis.

20. The use of claim 17, wherein the inflammatory condition is neurogenic inflammation, e.g., associated with headache, neuropathy (e.g., diabetic neuropathy, peripheral neuropathy, Lewy body neuropathy), epilepsy, systemic sclerosis, multiple sclerosis, amyotrophic lateral sclerosis, Alzheimer's Disease, Parkinson's Disease, white matter hyperintensities, diabetic retinopathy, anxiety, post-traumatic stress disorder, chronic fatigue syndrome, fibromyalgia, depression, insomnia, arthritis, rheumatoid arthritis, allergic rhinitis, dilative cardiomyopathy, atherosclerosis, cardioprotection, heart failure, hypertension (e.g., pulmonary hypertension, gestational hypertension, portal hypertension), eclampsia, pre-eclampsia, capillary rarefaction, peripheral vasculopathy, gestational diabetes, type 2 diabetes, obesity, metabolic syndrome, kidney failure, liver failure, pancreatitis, or hepatitis.

21. The use of claim 4, wherein the nasal or sinus disorder relates to an allergen, a bacterial infection, or a viral infection, e.g., the coronavirus, rhinovirus, meningitis, or influenza.

22. The use of claim 5, wherein the inflammatory condition is associated with an injury, cancer, or an infection.

23. The use of any of claims 2-22, wherein the preparation is to be administered preceding or following a medical procedure, e.g., a catheterization, endoscopy, intubation, e.g., nasogastric intubation, administration of a nasal cannula, or a dental procedure.

24. The use of claim 5, wherein the inflammatory condition follows an injury, e.g., spinal cord injury, head trauma, or brain injury.

25. The use of claims 4, wherein the nasal or sinus disorder is characterized by congestion or sinus pressure.

26. The use of claim 3, wherein the neurological disorder is a degenerative disorder or a genetic disorder.

27. The use of claim 26, wherein the neurological disorder comprises a psychological disorder.

28. The use of any of claims 2-27, wherein a deposit tissue, target tissue, or both is a mucous membrane of the subject.

29. The use of any of claims 2-28, wherein a deposit tissue, target tissue, or both is associated with a nasal cavity of the subject.

30. The use of any of claims 2-29, wherein a deposit tissue, target tissue, or both is a nasal cavity, septal wall, nasal valve, nostril, nasopharanyx, vestibular area, turbinate (e.g., inferior, middle, superior), meatus (e.g., inferior, middle, superior), concha (e.g., inferior, middle, superior), maxillary sinus, sphenoidal sinus, sphenoethmoidal recess, ethmoidal bulla, semi-lunar hiatus, nasolacrimal duct, frontonasal duct, or olfactory region of the subject.

31. The use of any of claims 28-30, wherein the target tissue is associated with a desired local effect.

32. The use of claim 28-30, wherein the target tissue is associated with a desired systemic effect.

33. The use of claims 32, wherein the desired systemic effect involves treatment of one or more of: headaches, cardiovascular diseases, inflammation, immune responses, autoimmune disorders, liver diseases, infections, neurological diseases, psychiatric disorders, nitric oxide disorders, urea cycle disorders, congestion, vasodilation disorders, skin diseases, wound healing, reactions to insect bites, ophthalmic disorders, connective tissue disorders, and certain viral, bacterial, or fungal infections.

34. The use of any of claims 2-33, wherein an effective amount of the preparation is to be administered to promote endothelial function.

35. The use of any of claims 2-34, wherein an effective amount of the preparation is to be administered to change or alter a level of nitrite or NO at a target tissue or in circulation.

36. The use of any of claims 2-35, wherein an effective amount of the preparation is to be administered to modulate a microbiome associated with the intranasal system of the subject.

37. The use of any of claims 2-36, wherein an effective amount of the preparation is to be administered to modulate a microbiome associated with the CNS of the subject.

38. The use of any of claims 2-37, wherein an effective amount of the preparation is to be administered to modulate a systemic microbiome associated with a remote system, e.g., gastrointestinal system, circulatory system, respiratory system, endocrine system, or immune system, of the subject.

39. The use of any of claims 2-38, wherein the preparation is to be administered device-assisted.

40. The use of any of claims 2-39, wherein the preparation is to be administered prior to onset of an inflammatory condition.

41. The use of any of claims 2-40, wherein the preparation is to be administered during incidence of an inflammatory condition.

42. The use of any of claims 2-41, wherein the preparation is to be administered subsequent to the subsiding of an inflammatory condition.

43. The use of any of claims 2-42, wherein the preparation is to be administered in response to an inflammatory symptom, trigger or warning sign, e.g. discomfort, a change in sinus pressure, or a stress state.

44. The use of any of claims 2-43, wherein it is determined whether the subject is in need of treatment for a neurological disorder.

45. The use of any of claims 2-44, wherein it is determined whether the subject is in need of treatment for a nasal or sinus disorder.

46. The use of any of claims 2-45, wherein the preparation is to be administered as a solution, suspension, emulsion, ointment, bougie, powder, gel, hydrogel, or liquid, e.g. drop, spray, aerosol, or mist.

47. The use of any of claims 2-46, wherein the preparation is formulated as a drop, spray, aerosol, or mist.

48. The use of any of claims 2-47, wherein the preparation includes microspheres or microcapsules.

49. The use of any of claims 2-48, wherein the preparation is formulated to be compatible with the mucous membrane of the nasal cavity of the subject.

50. The use of any of claims 2-49, wherein the preparation is to be administered to reduce inflammation, congestion, sinusitis, asthma, sneezing, sinus pressure, or discomfort in the subject.

51. The use of any of claims 2-50, wherein the preparation is formulated for immediate release or extended release.

52. The use of any of claims 2-51, wherein the preparation is formulated to deliver nitrite or NO to a target tissue, locally or systemically.

53. The use of any of claims 2-52, wherein the preparation is formulated for transmucosal delivery and/or circulation, *e.g.* locally or systemically.

54. The use of any of claims 2-53, wherein a second amount of the preparation is to be further administered to the subject.

55. The use of any of claims 2-54, wherein the preparation is to be administered as part of a combination therapy.

56. The use of any of claims 2-55, wherein a second treatment is to be administered in combination with the preparation.

57. The use of claim 56, wherein the preparation is to be administered for a period of time prior to initiating the second treatment.

58. The use of claim 56, wherein the preparation is to be administered concurrently with the second treatment.

59. The use of claim 56, wherein the preparation is to be administered for a period of time subsequent to ceasing the second treatment.

60. The use of claim 56, wherein the second treatment is to be administered via an alternate mode of administration, e.g. via inhalation or enteral technique.

61. The use of any of claims 2-60, wherein the subject has a therapeutic level of a second treatment.

62. The use of any of claims 2-61, wherein the preparation is to be administered in conjunction with an anti-inflammatory agent.

63. The use of any of claims 2-62, wherein the preparation is to be administered in conjunction with a medical approach that treats, e.g., is approved to treat or is commonly used to treat, the relevant disease or disorder, or a symptom of the relevant disease or disorder.

64. The use of any of claims 2-63, wherein the preparation is to be administered before or after a surgical or diagnostic procedure.

65. The use of any of claims 2-64, wherein the preparation is to be administered in conjunction with a decongestant, probiotic, therapeutic, exercise, or stress management.

66. The use of any of claims 2-65, wherein the preparation is to be administered in combination with a therapeutic treatment for headache, neuropathy (e.g., diabetic neuropathy, peripheral neuropathy, Lewy body neuropathy), epilepsy, systemic sclerosis, multiple sclerosis, amyotrophic lateral sclerosis, Alzheimer's Disease, Parkinson's Disease, white matter hyperintensities, diabetic retinopathy, anxiety, post-traumatic stress disorder, chronic fatigue syndrome, fibromyalgia, depression, insomnia, arthritis, rheumatoid arthritis, allergic rhinitis, dilative cardiomyopathy, atherosclerosis, cardioprotection, heart failure, hypertension (e.g.,

pulmonary hypertension, gestational hypertension, portal hypertension), eclampsia, pre-eclampsia, capillary rarefaction, peripheral vasculopathy, gestational diabetes, type 2 diabetes, obesity, metabolic syndrome, kidney failure, liver failure, pancreatitis, or hepatitis.

67. The use of any of claims 2-66, wherein the preparation is to be administered in conjunction with nitrite, nitrate, and/or NO.

68. The use of any of claims 2-67, wherein the effective amount is a therapeutically effective dose of AOM.

69. The use of any of claims 2-68, wherein the therapeutically effective dose of AOM is or greater than 1 x 10^3, 10^4, 10^5, 10^6, 10^7, 10^8, 10^9, 10^{10}, 10^{11}, 10^{12}, 10^{13}, or 10^{14} CFU.

70. The use of any of claims 2-69, wherein the preparation is to be administered as an analgesic.

71. The use of any of claims 2-70, wherein the preparation is to be administered as a prophylactic.

72. The use of any of claims 2-71, wherein the preparation is to be self-administered.

73. The use of any of claims 2-72, wherein the preparation is to be administered about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, or 24 times per day.

74. The use of any of claims 2-73, wherein the preparation is to be administered for about 1-3, 3-5, 5-7, 7-9, 5-10, 10-14, 12-18, 12-21, 21-28, 28-35, 35-42, 42-49, 49-56, 46-63, 63-70, 70-77, 77-84, or 84-91 days.

75. The use of any of claims 2-74, wherein the preparation is to be administered within 30, 60, 90, 120, 150, or 180 minutes of the subject waking from sleep.

76. The use of any of claims 2-75, wherein the preparation is to be administered within 30, 60, 90, 120, 150, or 180 minutes prior to the subject sleeping.

77. The use of any of claims 2-76, wherein the preparation is to be administered within 30, 60, 90, 120, 150, or 180 minutes of the subject eating.

78. The use of any of claims 2-77, wherein the preparation is to be administered 30, 60, 90, 120, 150, or 180 minutes before the subject cleanses or showers.

79. The use of any of claims 2-78, wherein the subject is female.

80. The use of any of claims 2-79, wherein the subject is male.

81. The use of any of claims 2-80, wherein the subject is characterized as one of the following ethnicity/race: Asian, black or African American, Hispanic or Latino, white, or multi-racial.

82. The use of any of claims 2-81, wherein the subject has a disrupted microbiome.

83. The use of any of claims 2-82, wherein the subject is of an age less than 1, or between 1-5, 5-10, 10-20, 20-30, 30-40, 40-50, 50-60, or over 60 years.

84. The use of any of claims 2-83, wherein the preparation comprises AOM in a buffer solution, e.g., an aqueous buffer solution.

85. The use of claim 84, wherein the buffer solution, e.g., aqueous buffer solution, comprises disodium phosphate and magnesium chloride, for example, 50 mM Na_2HPO_4 and 2 mM $MgCl_2$ in water.

86. The use of claim 84, wherein the buffer solution e.g., aqueous buffer solution, consisting essentially of disodium phosphate and magnesium chloride, for example, 50 mM Na_2HPO_4 and 2 mM $MgCl_2$ in water.

87. The use of claim 84, wherein the buffer solution, e.g., aqueous buffer solution, consists of disodium phosphate and magnesium chloride, for example, 50 mM Na_2HPO_4 and 2 mM $MgCl_2$ in water.

88. The use of any of claims 2-87, wherein the preparation is characterized by a physiological pH level.

89. The use of any of claims 2-88, wherein the preparation further comprises or is to be administered concurrently with a compound that promotes growth or metabolism of the AOM, NO production, and/or urease activity.

90. The use of any of claims 2-89, wherein the preparation comprises at least one of ammonia, ammonium salts, and urea.

91. The use of any of claims 2-90, wherein the preparation comprises a controlled release material, e.g., slow release material.

92. The use of any of claims 2-91, wherein the preparation further comprises an excipient, e.g., a pharmaceutically acceptable excipient.

93. The use of claim 92, wherein the excipient comprises an absorption or penetration enhancer, preservative, antioxidant, buffer, chelating agent, ion exchange agent, solubilizing agent, suspending agent, thickener, surfactant, wetting agent, tonicity-adjusting agent, enzyme inhibitor, or vehicle for proper drug delivery.

94. The use of any of claims 2-93, wherein the preparation comprises a mucoadhesive agent.

95. The use of any of claims 2-94, wherein the preparation includes a disintegrant, chelator, coating agent, modified-release product, or filler.

96. The use of any of claims 2-95, wherein the preparation is substantially free of other organisms.

97. The use of any of claims 2-96, wherein the preparation comprises between 1 x 10^3 CFU/mL to 1 x 10^{14} CFU/mL AOM.

98. The use of any of claims 2-97, wherein the preparation comprises between 1 x 10^9 CFU/mL to 10 x 10^9 CFU/mL AOM.

99. The use of any of claims 2-98, wherein the AOM comprise ammonia oxidizing bacteria (AOB).

100. The use of any of claims 2-99, wherein the AOM consist essentially of AOB.

101. The use of any of claims 2-100, wherein the AOM consist of AOB.

102. The use of any of claims 2-101, wherein the AOM comprise *Nitrosomonas*, *Nitrosococcus*, *Nitrosospira*, *Nitrosocystis*, *Nitrosolobus*, *Nitrosovibrio*, and combinations thereof.

103. The use of any of claims 2-102, wherein the AOM is *Nitrosomonas eutropha* (*N. eutropha*).

104. The use of any of claims 2-103, wherein the AOM is *N. eutropha* D23, having ATCC accession number PTA-121157.

105. The use of any of claims 2-104, wherein the AOM comprise ammonia oxidizing archaea (AOA).

106. The use of any of claims 2-105, wherein the AOM are capable of converting ammonia or ammonium to nitrite at a rate of at least about 1 pmol/min/mg protein, e.g., at least about 0.1 nmol/min/mg protein.

107. The use of any of claims 2-106, wherein the preparation is to be administered, e.g., intranasally to a first tissue, e.g. a deposit tissue.

108. The use of claim 107, wherein the first tissue is the target tissue.

109. The use of claim 107, wherein the first tissue is other than the target tissue, e.g., the preparation is to be applied to a first tissue and the preparation, or a product of the preparation, e.g., NO, is to be transported, e.g., by diffusion, to a second tissue, e.g. the target tissue.

110. The use of claim 56, wherein the second treatment comprises a surgical procedure.

111. The use of claim 92, wherein the excipient comprises an anti-adherent, binder, coat, disintegrant, filler, flavor, color, lubricant, glidant, sorbent preservative, or sweetener.

112. The use of any of claims 2-111, wherein a biome-friendly product is used in connection with the preparation comprising AOM.

113. A preparation comprising AOM, as defined in any of the preceding claims, for intranasal administration to a subject.

114. The preparation of claim 113, wherein the preparation is a nasal drop, spray, aerosol, or mist.

115. A preparation comprising AOM, as defined in any of the preceding claims, for use in the treatment of a neurological disorder in a subject.

116. A preparation comprising AOM, as defined in any of the preceding claims, for use in the treatment of a nasal or sinus disorder in a subject.

117. The preparation of claims 113-116, wherein the preparation is packaged for single use.

118. The preparation of any of claims 113-116, wherein the preparation is packaged for multiple use.

119. The preparation of any of claims 113-118, comprising AOM and other organisms, e.g., a community of organisms.

120. A device configured to administer a preparation comprising AOM, as defined in any of the preceding claims, to a target tissue of a nasal cavity of a subject.

121. A kit comprising a preparation comprising AOM as defined in any of the preceding claims.