WHAT IS CLAIMED IS:

1. A system for growing an edible aerial mycelium, comprising:

a growth matrix comprising a substrate and a fungal inoculum, wherein the fungal inoculum comprises a fungus;

a growth environment configured to incubate the growth matrix as a solid-state culture for an incubation time period;

a misting apparatus; and

an atmospheric control system with an electronic controller configured to maintain a carbon dioxide (CO_2) level within the growth environment between at least about 0.02% (v/v) and less than about 8% (v/v) and to introduce aqueous mist into the growth environment with the misting apparatus throughout the incubation time period, or a portion thereof, at a mist deposition rate and a mean mist deposition rate, wherein the mist deposition rate is less than or equal to about 150 microliter/cm^2/hour, and the mean mist deposition rate is less than or equal to about 3 microliter/cm^2/hour.

2. The system of claim 1, wherein the atmospheric control system is configured to maintain the growth environment at a relative humidity of at least about 95%.
3. The system of claim 1 or 2, wherein the atmospheric control system is configured to maintain the growth environment at a temperature within a range of 55° F to 100° F.
4. The system of any one of claims 1 to 3, wherein the atmospheric control system is configured to maintain the ratio of the mist deposition rate to the mean mist deposition rate within a range of about 100:1 to about 1000:1.
5. The system of any one of claims 1 to 4, wherein the aqueous mist comprises one or more solutes.
6. The system of any one of claims 1 to 5, wherein the misting apparatus is configured to deposit the aqueous mist onto the growth matrix, the extra-particle aerial mycelial growth, or both.
7. The system of any one of claims 1 to 6, wherein the system is configured to provide a substantially horizontal airflow across the growth matrix.
8. The system of claim 7, wherein the substantially horizontal airflow has a velocity of no greater than about 275 linear feet per minute.

9. The system of any one of claims 1 to 8, wherein the atmospheric control system is configured to maintain an O_2 level within the growth environment between a range of about 14% to about 21% (v/v).
10. The system of any one of claims 1 to 9, wherein the CO_2 level is within a range of about 0.2% to about 7% (v/v).
11. The system of any one of claims 1 to 10, wherein the fungus is a filamentous fungus.
12. The system of any one of claims 1 to 11, wherein the growth environment is a dark environment.
13. The system of any one of claims 1 to 12, wherein the substrate is a natural substrate.
14. The system of claim 13, wherein the natural substrate comprises a lignocellulosic material.
15. The system of claim 13, wherein the natural substrate comprises a cellulosic material.
16. The system of claim 15, wherein the cellulosic material is a lignin-free material.
17. The system of claim 13, wherein the natural substrate comprises an inorganic material.
18. The system of claim 17, wherein the inorganic material comprises a mineral-based material.
19. The system of any one of claims 1 to 18, wherein the fungal inoculum produces mycelium.
20. The system of claim 19, wherein the mycelium does not include any visible stipe, cap or spores.
21. The system of claim 19 or 20, wherein the mycelium grows vertically to produce an aerial mycelium.
22. The system of claim 21, wherein the aerial mycelium has a mean density of at least 1 pound per cubic food (pcf).
23. The system of claim 21 or 22, wherein the aerial mycelium has a mean thickness of at least 15 millimeters.