NSF SBIR Phase I – Project Outcomes

Project Title: **Project Morchella: A Scalable Indoor Cultivation Platform for Morel Mushrooms**

Recipient: ALL-IN PEPPERS AND SPECIALTY PRODUCE LLC ("ALLinAG")
Recipient Address(es): 85 Jacob Ave, Oshkosh, WI 54902
1360 Old Skokie Rd #2N, Highland Park, IL 60035

Recipient Email Address: j.ermel@allinspecialtyproduce.com
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Authors:	Charlie Bry	Project Lead Mycologist
	John-Michael Ermel	Co-Founder and Principal Investigator
	John James Staniszewski	Chief Mycologist
Academic Review:	Kevin Panke-Buisse, Ph.D.	Microbial Ecologist

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ALLinAG experienced an upheaval during the pursuit of this project. Our Founder, chief mycologist, and original Principal Investigator, Bradford Ermel, passed away suddenly and unexpectedly. This tragedy has had profound effects on us personally, our pursuits related to this proposal, and our future directions. Despite this, we are proud to present for review our final report after a brief discussion of the limitations and new directions created by these circumstances.

John-Michael Ermel, co-founder of ALLinAG, assumed the role of Principal Investigator and appointed John James Staniszewski and Charlie Bry as the mycological team for the endeavor of fulfilling our Phase I objectives. Despite challenges, we were able not just to address our original objectives but to accomplish novel innovations well-suited to subsequent NSF SBIR Phase II proposal. We are pleased to present our progress and accomplishments in loving memory of Bradford Ermel.

Project Morchella: A Breakthrough in Cultivated Fungi

Fresh morel mushrooms are a highly sought-after delicacy, commanding premium prices and driving a global market that's largely dependent on seasonal wild harvests. This reliance on nature has long limited the scalability and reliability of the supply chain. While previous cultivation efforts in regions like China and Europe have seen some success, consistent and reliable cultivation in North America has remained elusive. Project Morchella was initiated to overcome these challenges by developing a pioneering approach to bring *Morchella americana*, the prevalent morel species in this region, into a controlled, indoor environment.

Our initial efforts focused on creating an indoor process for producing morel sclerotia and fruiting bodies. However, we quickly encountered significant challenges in replicating the precise environmental conditions of our initial prototype at a larger scale. This is a common hurdle in both scientific and business innovation, and rather than being a roadblock, it became a pivotal learning opportunity. We adapted our strategy, shifting our focus to laying a stronger foundation of fundamental and applied science necessary for true commercial scalability.

Key Breakthroughs and Strategic Pivot

This strategic pivot yielded several key breakthroughs that have propelled us toward our ultimate goal. Our research built upon a robust foundation of prior work, including metabolic pathway studies, solid-state media optimization, and in-depth research into biochemical stress signaling. We also investigated the crucial role of oxygen and its effect on sclerotia development, as well as system integration approaches aimed at synchronizing media, substrate, and environmental parameters.

Based on this extensive work, we successfully screened various morel strains to identify those best suited for indoor cultivation. We also developed and optimized novel nutrient media, which efficiently induces the formation of sclerotia—the crucial initial step in morel fruiting. This liquid culture system offers greater reproducibility and efficiency compared to earlier methods, providing a scalable source of inoculum for our solid-state production.

Furthermore, we formulated and tested new, complex fruiting substrates designed to mimic the natural environment. The success of these substrates is rooted in our proprietary Nutrient Extrapolation Supplementation (NES) Protocol, which delivers specific nutrients and biochemical signals to the mycelium. This system provides a controlled release of nutrients for proper biochemical signaling across all growth stages.

These discoveries have informed the conceptual dsign of our next-generation pilot facility, a purpose-built environment for controlled fruiting with advanced controls for humidity, lighting, and temperature. This facility is the capstone of our initial development, designed to validate our new substrates and cultivation techniques, and is awaiting additional funding for execution.

Ultimately, our work confirms that indoor morel cultivation is not only possible but commercially viable. We've addressed major obstacles, including the challenge of consistent fruiting body size and flavor, by identifying promising new cultivation techniques. Our findings suggest that with further optimization, our system can consistently produce high-quality mushrooms that meet market demands. We have also identified alternative markets for morel products, such as nutritional powders and flavor extracts, which can utilize mushrooms of all sizes.

Our path forward is guided by a Derivative Commercialization Model, a multi-faceted approach that extends beyond simply growing morels. This model is designed to create value on multiple fronts, including food localization and accessibility, job creation within local economies, and the advancement of sustainable food systems.

We are confident that with sustained support, our project will not only achieve the historic milestone of commercial morel cultivation but also deliver a wide range of tangible benefits to our communities and the broader agricultural industry.