PREMIUM FLAVOR IN STRAWBERRIES FOR INDOOR ENVIRONMENTS

REQUEST FOR APPLICATIONS

Key Dates

Pre-Application Open: October 13, 2021 at 12:00pm ET

Pre-Applications Due: November 10, 2021 5:00pm ET
NOTE: An approved pre-application with an invitation to submit a full application is required for submission.

Full Application Invitation: January 4, 2022

Full Applications Due: March 1, 2022 date 5:00 PM ET

Award Notification: Fall 2022

Anticipated Project Start Date: Winter 2022

CONTEXT/BACKGROUND

Food production in the 21st Century faces challenges ranging from climate change to increased competition with non-food sectors for scarce resources. To ensure we have the capacity to provide healthy and nutritious food for everyone, the food system needs to adapt. One aspect of adaptation is the exploration of new production methods, such as indoor agriculture, that have the potential to complement current production methods. Current public funding for indoor agriculture is lagging in the private sector, where funding is largely spent on engineering, lighting, and decision-support tools. However, success in this industry will depend on profitably growing a diverse range of crops indoors, a herculean task requiring adaptation of the crops themselves. The Foundation for Food & Agriculture Research (FFAR) created the Precision Indoor Plants collaborative (PIP), a public-private partnership, to increase public and private sector investments in adapting crops to indoor environments. PIP aims to fund innovative science and technology to increase our ability to produce high-value crops that are desired by consumers. PIP's current focus is on four crops: lettuce, tomato, strawberry, and kale. This request for applications (RFA) is specifically for strawberry.

For strawberry, there are a number of public and private efforts with the goal of adapting strawberries to indoor environments largely focused on yield and flavor as it relates consumer likability in commercial cultivars. This RFA aims to build on the years of

strawberry research, including flavor research, to increase our scientific understanding of premium flavors in strawberry, with the potential to impact the indoor agriculture market. Premium flavors are defined here as novel flavors with potential commercial value that are largely absent in modern commercial cultivars, not the enhancement of flavor in most existing modern cultivars. Strawberries have a range of diverse flavors that have been lost in modern cultivars (Aharoni et al, 2004) but still exist in nature and in public and private germplasm collections. As a combination of volatiles, acids, and sugars, all of which are controlled by genetics and the environment (Klee & Tieman, 2018; Whitaker et al, 2020; Campbell et al., 2020; Fan et al, 2021; Schwieterman et al, 2014), flavor is complex.

In strawberry fruit, there are over 300 reported volatiles (Yan et al., 2018) with several of them implicated in strawberry flavor. While knowledge of the differences between volatiles present in wild and commercial strawberries is increasing (Vallarino et al., 2018; Morales-Quintana et al., 2019; Ulrich et al., 2018; Ulrich et al, 2007; Prat et al., 2014), much less is known regarding the genetic and environmental regulation of the metabolic networks responsible for the volatiles, including for flavor production (Chambers et al., 2014; Lu et al, 2021; Fan et al, 2021a). Given the environmental role in secondary metabolic control, research in precisely controlled environmental conditions will greatly advance our understanding of the genetic, metabolic, and environmental components responsible for creating flavor. In addition, advancements in metabolomics are currently being applied to crop improvement (Pavagadhi & Swarup, 2020; Razzaq et al., 2019; Kumar et al, 2017), and identification of metabolites paired with data from consumer and sensory panels has led to consumer preferences predictions based off the biochemicals present (Fan et al., 2021b; Colantonio et al 2020). This RFA is being released at a time where scientific advancements can lead to more rapid progress in strawberry flavor research.

What FFAR is looking for:
This RFA encourages applications focused on increasing the scientific understanding of genetic and biochemical elements responsible for premium flavors, in addition to the environmental control of these elements. A project funded through this RFA **MUST** identify:

- Genetic elements responsible for premium flavors,
- Chemical constituents (such as volatiles) responsible for premium flavors, and
- Environmental recipes that lead to the development of strawberries with premium flavors grown in completely controlled indoor production systems.

Program Requirements
The Precision Indoor Plants Collaborative is interested in understanding the genetics, biochemistry, and environmental conditions that give rise to strawberries with premium flavors, enabling the production of premium flavored strawberries in indoor environments.

Identification of the genetic components that give rise to premium flavors and the manipulation of chemicals responsible for that flavor through environmental control will be key. However, the science behind this is complex and PIP is interested in increasing our understanding of how to produce premium flavors in strawberries. Ultimately, PIP is looking to fund projects that:

- Focus on one (1) premium flavor determined by the applicant with the following considerations:
    1. Non-commercial cultivar flavors: flavors that represent what cannot be found in modern commercial cultivar flavors,
    2. Focus on flavors with commercial potential, such as:
        - Tropical flavors like pineapple,
        - Novel flavors such as: Hawaiian Punch, SweeTarts, etc.
- Investigate how to produce the premium flavor: including the sensory attributes associated with the premium flavor;
- Identify genetic elements: including, but not limited to, genetic markers that facilitate breeding for premium flavors and genes responsible for premium-flavor molecules or modifiers (genetic, metabolic, others) that contribute to the premium flavor;
- Identify flavor molecules: molecules responsible for producing the premium flavor;
- Identify environmental recipes: environmental conditions that enhance or diminish the premium flavor in addition to the environmental conditions to manipulate concentrations of flavor molecules; and
- Develop varieties or recipes that lead to a minimum 2x-4x increase in yield from plants producing the premium flavor relative to the starting low-yielding variety, where applicable.

Types of activities we will not consider:

- Projects that focus on the indoor productions systems themselves will not be considered. Engineering aspects related to HVAC or lighting, if included, should be minimal.
- Projects focused solely on improving consumer likability of modern commercial strawberry cultivars, or solely focused on Brix/acid ratios, rather than "novel" or "unique" flavor profiles will not be considered.

Eligibility

The Foundation for Food & Agriculture Research welcomes applications from institutions of Higher Education, non-profit and for-profit organizations, government-affiliated researchers, and domestic and international organizations.

Any individual(s) with the skills, knowledge, and resources necessary to carry out the proposed research as Program Director(s)/Principal Investigator(s) is invited to work with their organization to develop an application for support.

If a proposal includes a for-profit entity as either the applicant institution or support for an application, that for-profit entity must provide at least 5% of the total project budget requested from FFAR.

In keeping with FFAR goals to reach a diverse and broad range of institutions and individuals who participate in its programs, the following types of higher education institutions are encouraged to apply for FFAR programs:

- Hispanic-serving Institutions
- 1890s Land Grant Institutions and other Historically Black Colleges and Universities
- Tribal Colleges and Universities
- Alaska Native and Native Hawaiian Serving Institutions
- Asian American and Native American Pacific Islander Serving Institutions

Award Information

- Anticipated Project Duration: up to 48 months
    - Total Amount Available from FFAR: up to $1.8M. Each for-profit institution that is part of an application, as either the lead institution or support for an application, must contribute at a minimum, 5% cash match of the total budget amount being requested from FFAR.
- Estimated Number of Awards: One (1). FFAR reserves the right to negotiate all or none of the applications received for funding consideration.

Application Components

Pre-proposal

Required

- Contact information:
    - The applicant (applying organization)
    - Principal Investigator
    - Authorized Signing Official
    - Grant/Contract Administrator (if different from ASO)
- Title of the Proposed Project
- Proposed Project Overview (1500 words)
    - Describe selected premium flavor to be studied (250 words)
    - Describe the potential market for the selected premium flavor (250 words)
    - Describe project objectives (500 words)
    - Briefly describe the scientific methods for this study (250 words)
    - Describe anticipated deliverables and outcomes (250 words)
- Anticipated Project Budget
- Geographic Location(s) of Proposed Project
- Key Personnel Involved in the Project (Name(s), affiliation, expertise, role on the project)
- Collaborations: Project collaborators and their contributions to the project **MUST** be listed in the anticipated project budget. Invited full proposals that include additional for-profit institutions which were not submitted as part of the pre-proposal submission will be rejected.
- Funding Overlap: Are the PI and key personnel involved in other projects being submitted to FFAR?

Optional Information – will not affect the evaluation of the proposed project.

- How did you hear about this opportunity?
- Demographic Information

Full Proposal

1. Required
   b. Project Title
   c. Project Start and End Dates
   d. Geographic Location (city, state, congressional district) where the proposed research will be conducted.
   e. Proposed Total Budget
      - Total FFAR request
      - Total optional matching funds
      - Total proposed budget (FFAR funds + Optional Matching Funds)
   f. Budget Justification (up to 1000 words)
   g. Key Personnel
   h. Current and Pending Support
   i. Project Summary (500 words or page limit)
   j. Abstract (250 words)
   k. Project Description (5,000 words)
      Description must include:
      - Novel insights that can be gained about generating premium flavors in strawberry for completely controlled environments
      - Selected premium flavor to be studied
      - The potential market for the selected premium flavor
      - Project objectives
      - Scientific methods for this study
      - Anticipated deliverables and outcomes
      - Description of possible barriers and approaches for overcoming them
   l. Data Management Plan (800 words) In addition, full proposals must list data that will be shared with PIP partners—raw data and analysis of that data in the context of the project. Certain data are expected to be shared publicly. Data that is shared with PIP partners and the public is negotiable.
   m. References Cited
   n. Intellectual Property Management Plan (500 words)
   o. Organization Assurances
      - Research involving human subjects
      - Research involving vertebrate animals
      - Research involving Recombinant DNA
      - Research involving National Security implications
      - Research involving hazardous materials
      - Research involving human fetal tissue
      - Research involving NEPA review
   p. Attachments
      a. Required Attachments (templates and instructions can be found on FFAR's Applicant Forms & Examples website. To access, click here or type https://foundationfar.org/grants-funding/resources/forms-and-examples/ into a URL browser).

- Budget Form: There is no match required; however, each for-profit institution part of an application, as either the lead institution or support for an application must contribute at a minimum 5% of the amount requested from FFAR.
- Current and Pending Support
- PI and Key Personnel Biosketch: Five-page limit per individual listed as PI or key personnel in the project.

- Project Timeline (by year) and deliverables per every quarter of a project year.
- Gantt chart of Project Goals and Objectives (every quarter of a project year).

b. Optional attachments to support project description. This section should not be used to circumvent the page limit for the Research Program Plan Section.
   - Graphics, Figures, Equations, and Tables (up to five pages) - The textbox for the Research Program Plan does not support equations, tables, graphics, and figures. Applicants may upload a PDF document with graphics, figures, tables, or a list of equations to support the research program plan.
   - Letters of Support - Applicants may provide letters of institutional, collaborator, or stakeholder support for the proposed project. Please combine all letters of support into a single PDF document before uploading as an attachment.

Application Submission Guidelines

Applications must be submitted through FFAR's online Grant Management System. Applications not submitted through this portal will not be considered eligible for evaluation. To be fair to all our applicants, FFAR will not grant an extension to applicants who missed the deadlines posted in the Key Dates section.

If you are a new user, register for an account by clicking the "Create Account" button located under the email address field on the left side of the home page. Once you log in, you may begin working on your application. Please be sure to save your work often by clicking on "Save and Finish Later". To access a saved application, please do so through your Grant Management Account.

Application Review Process

Pre-Proposal

PIP will solicit pre-proposals that require minimal development. These pre-proposals will include aims that respond to the RFA, public and/or private sector partners (if applicable), and partner project contributions (if applicable). The PIP Executive Committee will review pre-proposals and invite back a select number of applicants.

Full Proposal Review

Submitted full proposals will undergo further review using a two-stage peer review process: (1) External Peer Review (Primary Review), and (2) PIP Executive Committee Review (Secondary Review). In the first stage, applications will be evaluated by an external

peer review panel of scientific experts using the proposal review criteria posted in the RFA. In the second stage, the top ranked proposals will be reviewed by the PIP Executive Committee. All reviewers are required to read and acknowledge acceptance of FFAR's Conflict of Interest Policy and Non-Disclosure Agreement. We make reasonable efforts to ensure that proposals are not assigned to reviewers with a real or apparent conflict with the applicant or project personnel. Reviewers with a conflict of interests are recused from evaluating or participating in the discussions of proposals with which they have a conflict. Each stage of the review is conducted confidentially.

Review Criteria

Full proposals are evaluated based on scored primary review criteria and unscored secondary review criteria. The bullets under each criterion may serve as a guideline to applicants when writing their proposals and as a guideline to reviewers on what to consider when judging proposals. The bullets are illustrative and not intended to be comprehensive. Reviewers will evaluate and score each primary criterion. The overall assessment will not be an average score of the individual criterions; rather, it will reflect the reviewers' overall impression of the application. Evaluation of the scientific merit of each application is within the sole discretion of the peer reviewers and they may raise additional factors to consider that are not covered in the bullets for each criterion.

a. Novelty and Innovation

- Does the proposal clearly define the premium flavor, market potential for that premium flavor, and scientific justification for pursuing the premium flavor?
- What novel insights can be gained about generating premium flavors in strawberry for completely controlled environments?

b. Project Strategy and Feasibility to Achieve Project Goals

- Is the proposal responsive to the RFA?
- Are the overall program approach, strategy, and design clearly described and supported by established theory and practice?
- Are the base of evidence and any necessary adaptations clearly defined and referenced?
- Are the proposed objectives and activities feasible within the duration of the award?
- Are possible barriers addressed and approaches for overcoming them proposed?
- Are the proposal deliverables clearly outlined with a feasible timetable for deliverable completion listed? Is this timetable realistic?

c. Scientific or Technical Merit

- Does the proposal utilize the best and most efficient scientific methods/techniques?
- Are the scientific methods/techniques suitable to achieve the project goals?

d. Organizational Capacity / Research Environment

- Will the research environment be appropriate for the projects intended goals?
- Does the described role of each collaborating organization make it clear that each organization adds value to the project and is committed to working together to implement the project?
- Is the appropriate infrastructure already in place?
- Does the proposal demonstrate that the project personnel would have adequate resources (for example, institutional support, equipment and/or other physical resources) to conduct the proposed research or associated activities?

e. Qualification of PI

- Have the appropriate personnel been recruited to implement, evaluate, and complete the project?
- Does the PI have a track record indicative of success in the current project?

f. Budget

- Is the budget appropriate and reasonable for the scope and services of the proposed work?
- Is the proportion of the funds allocated for direct services reasonable?

Award Administration

Selection Notice

Following the full proposal review, the Principal Investigator and the authorized organization representative listed on the project will be officially notified by email whether (1) the proposal has been selected for funding pending contract negotiations, or (2) the proposal has not been selected for funding. If a proposal is selected for funding, the Foundation for Food & Agriculture Research reserves the right to request additional or clarifying information for any reason deemed necessary, including, but not limited to, additional project contributions, or other budget information. Potential grantees should meet PIP's IP and data sharing requirements.

Award Notice

FFAR notifies applicants of whether they are selected for funding through email. The notice does not constitute an award or obligate funding from FFAR until there is a fully executed Grant Agreement.

Grant Period(s)

Upon receipt of the Grant Agreement, the potential grantee should note the Start Date and the End Date. Grantees may only use FFAR funds on project expenditures on or after the Start Date of the Grant. Charging expenditures to the grant prior to the effective date is strictly prohibited. Likewise, grantees may not use FFAR funds after the End Date except to satisfy obligations to pay allowable project costs committed on or before that date. The expiration date is the last day of a month.

Once the Grant Agreement is fully executed, the Start Date cannot be changed. The End Date may be changed with a written approval of a no-cost extension request by FFAR. If a no-cost-extension request is approved, FFAR will issue an amendment to the Grant Agreement.

If the grantee requires additional time beyond the Grant Period and the established End Date to assure adequate completion of the original scope of work within the funds already made available, the grantee may request a no-cost extension of up to 12 months. The request must be submitted to FFAR at least thirty (30) days prior to the End Date of the grant. The request must explain the need for the extension and include an estimate of the unobligated funds remaining and a plan for their use. This one-time extension will not be approved merely for using the unexpended funds.

Post-award Management

Reporting Requirements

After a grant is conferred, the grantee shall provide an annual financial report to FFAR, showing grant expenditures to date. The grantee shall present twice a year to the PIP Executive Committee on deliverables, results, and synthesis of the results as they relate to the project objectives. The grantee shall also provide quarter and annual progress reports to FFAR showing activities being carried out under the grant, including but not limited to project accomplishments to date, where data is stored, and synthesis of results. Within 90 days of the End Date, the grantee shall provide a final progress report. The final progress report should address the original objectives of the project as identified in the proposal, describe any changes in objectives, describe the final project accomplishments, and include a final project accounting of all grant funds.

Scientific Integrity

FFAR's ability to pursue its mission to build unique partnerships to support innovative science addressing today's food and agriculture challenges depends on the integrity of the science on which it relies. A fundamental purpose of FFAR is to facilitate the advancement of knowledge and the application of the science to address challenges relevant to FFAR's mission. All FFAR grants must be conducted with the highest standards of scientific integrity.

Requirement to Demonstrate Matching Funds

There is no matching funds requirement for this funding opportunity, however, if a for-profit institution is part of the proposal as the primary organization or collaborator, the project will need to have matching funds from that organization. Each for-profit institution participating in an application must contribute, at a minimum, 5% of the budget amount requested from FFAR.

Contact Information

All Scientific and Grants Questions must be emailed to grants@foundationfar.org

FFAR only accepts scientific, programmatic and grants inquiries by email. We strive to respond to inquiries within three business days, but our response time depends on the volume of questions we receive and the complexity of the questions asked. Please note that we do not monitor this mailbox on evenings, weekends, or federal holidays.

References

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