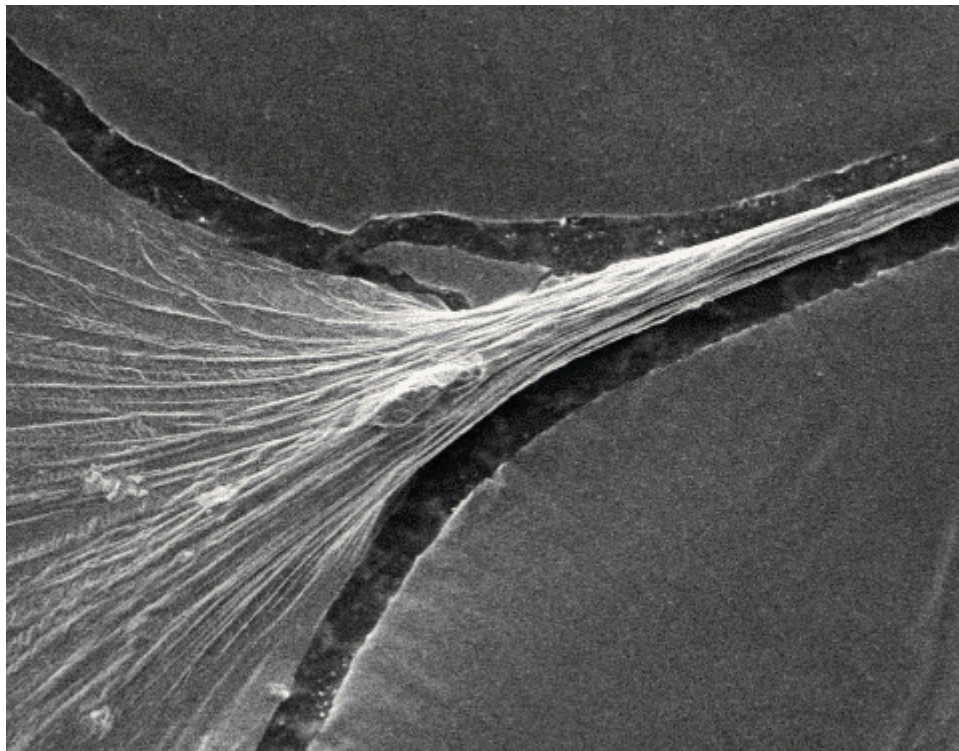




Hello New Harvest Community!

December is a favorite time for me - not just because of the holidays, but because of the vantage point that comes with the end of the year.



Our research is 100% powered by philanthropy. [Give today](#) to push cell ag forward!

2018 was an especially rewarding year to look back on. For the past several years, we've been grounded in our mission and thesis statement, rooted in research:

We want to see a world where food can be grown from cells instead of animals, to feed our global population sustainably and affordably.

Establishing the field of cellular agriculture is how we'll get there.

*To us, **scientific advancements** and the **trained scientists** who can make these advancements are the limiting factors holding back cellular agriculture's growth.*

New Harvest is building a foundation of cellular agriculture research and a community of cell ag scientists that will bring us closer to our goal.

In mid-2017, we on-boarded Dr. Kate Krueger, Research Director, to turn our fledgling ideas about advancing cellular agriculture science into a well-designed research program. Thanks to her thoughtful approach and our strategic deployment of funds, we are seeing incredible impact from our blossoming research community.

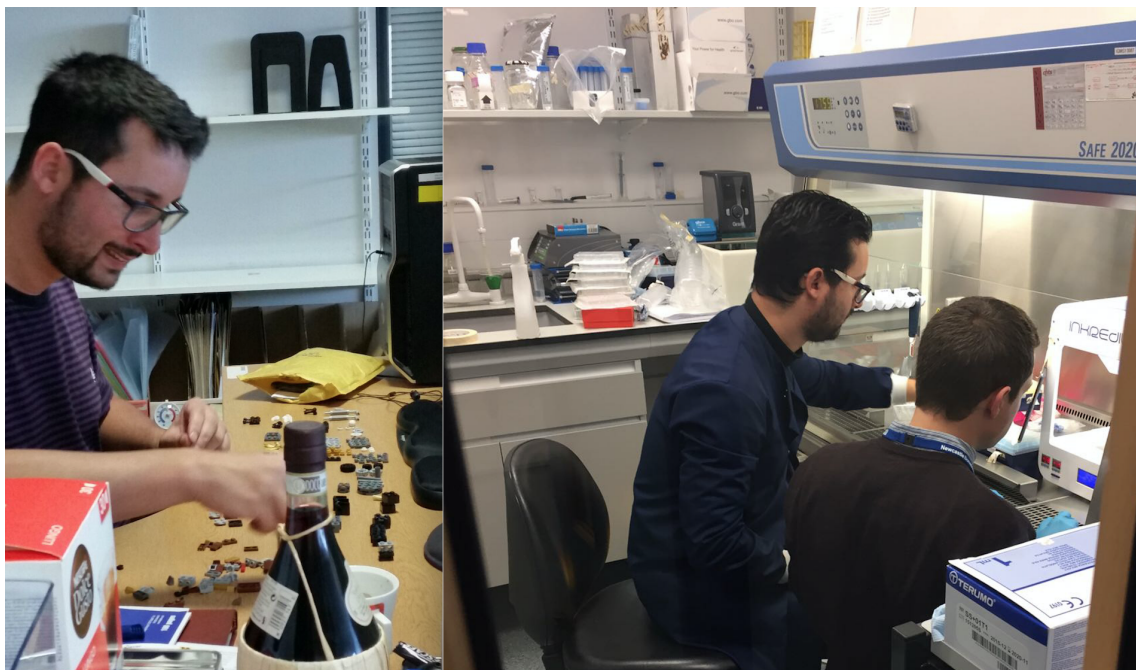
While we don't have the space in this mailout to capture *all* of our research output here (stay tuned for the annual report!), here are some highlights of the past year:

2018 RESEARCH SNAPSHOT

- + We spent **over 50% of our annual budget** on laboratory research
 - + We funded **9 research projects**: 6 fellowships, 1 seed grant, and 1 build
 - + Our projects employed **16 laboratory scientists and engineers**
 - + We have **8 publications** in the works: 2 published in journals, 1 on GitHub, 5 in peer review,
 - + Our review and revision process mobilized **24 scientific advisors** across multiple disciplines
-

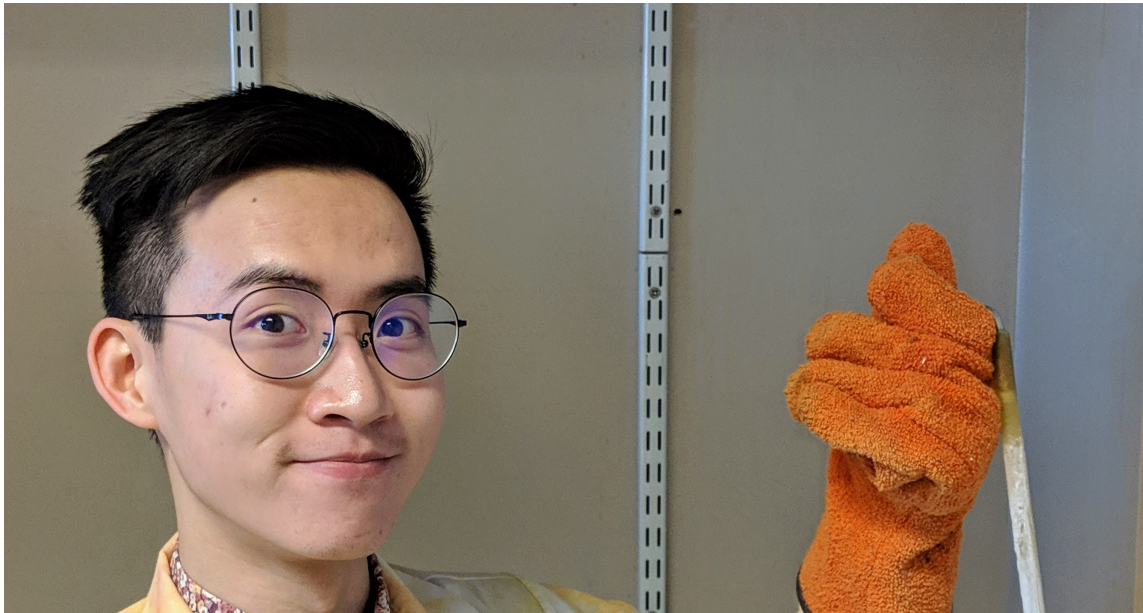
Our Newest Research Fellows

New Harvest is pleased to announce its 2018 fellows: Dr. Ricardo Gouveia and John Yuen.



Ricardo, on the left using lego to make a customized motorized stage for microscopy, and on the right at the tissue culture hood, demonstrating a technique

- Dr. Ricardo Gouveia is New Harvest's first ever postdoctoral fellow. Ricardo earned his undergraduate and doctoral degrees from the University of Lisbon in 2009, earning the award for best PhD thesis from the Instituto de Tecnológica Quimica e Biologica. Dr. Gouveia works in [Dr. Che Connon's lab at the University of Newcastle](#), where he will be studying the effects of curved surfaces on muscle cell growth and self-organization. **His work is key to developing cheaper and simpler ways to produce structured muscle tissues using techniques that he has previously developed for non-muscle tissues.** Once he has generated muscle tissue, Ricardo will test its structure and the composition using high-resolution techniques such as atomic force microscopy and confocal immunofluorescence imaging. Dr. Gouveia has published extensively on subjects ranging from glycobiology to bioactive films. He believes his multidisciplinary approach in the lab (and listening to chamber music for inspiration) will improve his contributions to cellular agriculture. This work is his first foray into the field, and an important piece of research bringing us closer to developing structured muscle tissues for food. When he's not in the lab, Ricardo is also an avid trekker and reader, and he satiates his immense appetite for exploration by travelling across the world – or through a good book!



John, highlighting the cell ag portion of the cell freezer!

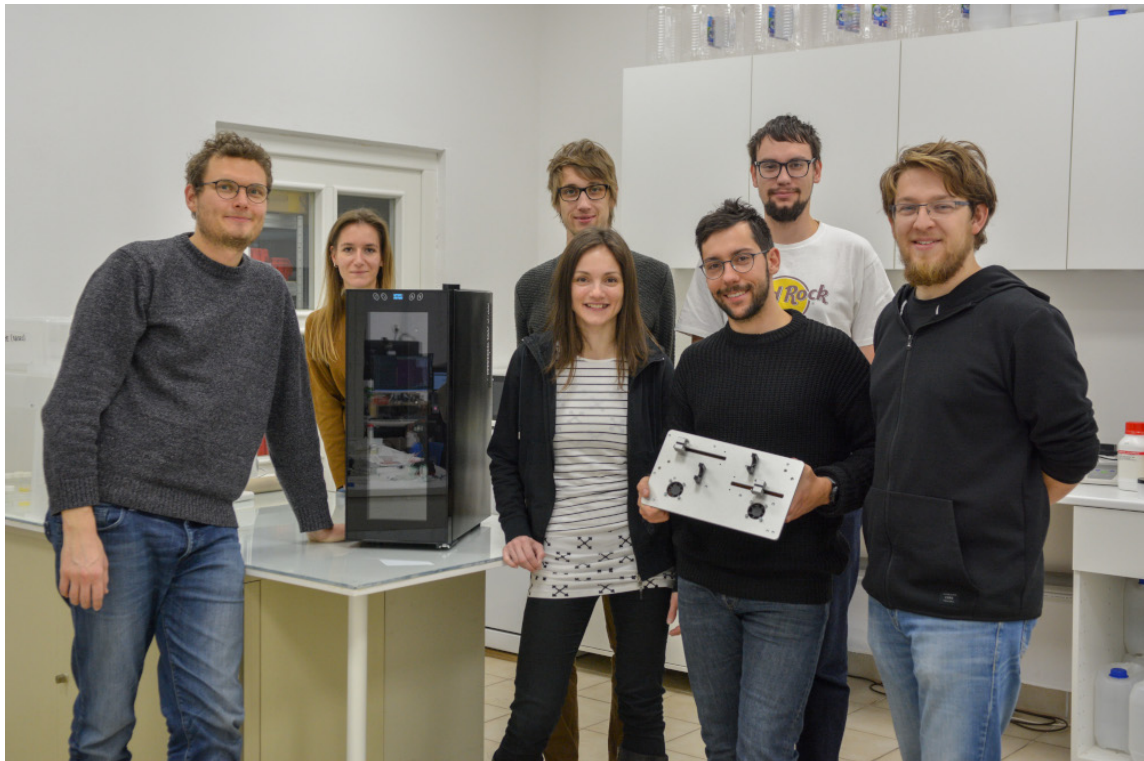
- John Yuen completed his undergraduate degree in molecular biology and master's degree in biology at University of California, San Diego. He is a second-year doctoral student in biomedical engineering at [Tufts University](#), [in the lab of Dr. David Kaplan](#). His research focuses on novel RNA technologies to coax muscle cells into a growth state for better cultivation. Unlike many approaches to cell modification, John's work will not result in permanent changes to cellular DNA. **This approach will render cells that are suitable for cultivation that are not genetically modified.** His approach will consist of cutting edge molecular biological techniques including CRISPR/Cas9. The aim of this work is the development of a new technique for transiently immortalizing muscle satellite cells, and somatic cells in general, without the need for genetic modifications. This could have enormous impact for the development of cell-based meats. John's skills range from materials fabrication to biofabrication, microscopy, molecular biology, and programming in the lab. Outside the lab, his

interests include learning languages like Spanish and fabrication – including building a bamboo bicycle.

This brings our fellowship program up to 6 active fellows and 3 alumni. Stay tuned for progress on Ricardo and John's work!

Our Design & Build Project

In addition to refining and perfecting our established programs, we spend a portion of our time on exploratory projects that can also help us advance our mission. This year, that included a bioreactor design and build project, with the help of [IRNAS](#), a hardware innovation lab, our research fellow Jess Krieger, and the input of a few advisors and other fellows in our current program.



The IRNAS team with the bioreactor prototype!

The goal was to build a prototype modular bioreactor for muscle tissue engineering - a tool that could be used by researchers around the world to accelerate cultured meat science.

The next phase will be putting the bioreactor to the test in the tissue engineering lab!

Engaging Around Research

Telling the story of cellular agriculture is not enough - to push a field forward, we need to illuminate the forefront of science. This year we broadened the cellular agriculture community through events, outreach, and publications.

- **Scientific conferences:** Research Fellow Jess Krieger stole the show at the [American Meat Science Association's](#) annual conference, bringing the science of cultured meat to the largest gathering of meat scientists in the US; Jess and Natalie brought their work to the [Tissue Engineering and Regenerative Medicine International Society \(TERMIS\)](#) meeting in Kyoto; Natalie and Scott shared their research at the [International Conference on Cultured Meat](#) in Maastricht. And those are just the events we presented at!
- **Research progress at the New Harvest Conference:** Our fellowships are multi-year projects, but it's important to share progress as it happens. This year we showcased the work of fellows Jess Krieger and Andrew Stout on stage, and the work of Natalie Rubio in the exhibition hall.



Jess Krieger covers [the interdisciplinary pursuit of cultured meat research](#)



Andrew covers [the metabolism of muscle cells and his use of open access data](#)

- **Student-run university engagement:** Kate illuminated the cellular agriculture research landscape at student-organized events at NYU, Columbia, Yale, and UPenn, targeting students with a particular interest in pursuing cellular agriculture careers.

Cell-Based Fish: A Novel Approach to Seafood Production and an Opportunity for Cellular Agriculture

Natalie Rubio , Isha Datar , David Stachura , Kate Krueger *

Version 1 : Received: 12 November 2018 / Approved: 14 November 2018 / Online: 14 November 2018 (08:50:01 CET)

How to cite: Rubio, N.; Datar, I.; Stachura, D.; Krueger, K. Cell-Based Fish: A Novel Approach to Seafood Production and an Opportunity for Cellular Agriculture. *Preprints* **2018**, 2018110326 (doi: 10.20944/preprints201811.0326.v1).

- **New frontiers for cellular agriculture: seafood!** Kate oversaw the preparation and writing of the first ever publication on cell-based seafood production. She engaged a new community of scientists around cell ag while exploring a new application for the technology. What did we find? That fish muscle has some notable characteristics that may make it particularly well-suited for cell culture. This could be a boon for cellular agriculture research as well as ocean health. The paper is currently in peer-review, but you can [read the fully accessible pre-print here](#).

Advocating for Research

A major turning point for cellular agriculture came with the three meetings held by US regulators this year. These meetings allowed us to emphasize New

Harvest's role as a resource of scientific expertise and peer-reviewed research.

- [July 12, 2018](#): This public meeting held by the FDA - the first of its kind in 10 years (!!) - was put together to better understand the technology behind cell cultured meat. New Harvest was invited to speak on a panel presentation about the science of cultured meat, quite an unprecedented invitation to be part of food biotech regulatory policy.
- [October 22, 2018](#): This meeting of the FDA scientific advisory board was our favorite - it convened scientists to discuss how, exactly, these technologies might be evaluated and regulated. **[Have a read through the comments we provided, highlighting the need for government funding for cellular agriculture research.](#)**
- [October 23 & 24, 2018](#): This joint USDA/FDA public meeting discussed cultured meat technology in light of how the USDA and FDA co-operate in regulatory activities. You can watch a clip of our formal public comments below!



- The meetings also allowed us to drive the point home: **The basis of good governance and good regulation is informed by evidence and peer-reviewed research. Federally-funded research is an important part of this equation.** We hope these conversations, coupled with our efforts, lead to major government funding for cellular agriculture work down the road.

Research Quote of the Month

"Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less."

21 December 2018

— Marie Curie, physicist and chemist, and the only person to win a Nobel prize
in two different sciences

Thank you so much for fearlessly advancing cellular agriculture with us.

Can't wait to share what happens next.

All the best in 2019,

A handwritten signature in black ink, appearing to read 'Isha'.

Executive Director, New Harvest

****Don't forget! All donations up to \$100,000 are being matched!****

Donate Now!

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EIN/tax ID number: 20-1425438

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