Algae4IBD: A holistic approach to IBD treatment

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The Algae4IBD project is exploring the untapped potential of algae and cyanobacteria to manage inflammatory bowel disease (IBD). In this exclusive Q&A, Dr. Dorit Avni, Research Group Leader explains how the team are creating innovative functional foods, aiming to improve quality of life and prolong remission for patients worldwide

Can you give us a brief overview of what inflammatory bowel disease is and why it's so challenging to treat?

Inflammatory bowel disease (IBD) is a chronic, ongoing inflammation in the gut. It's an umbrella term for two specific diseases: Crohn's disease and colitis, which affect different areas of the gut system/digestive tract.

IBD is a concerning global problem, not only because the number of patients is increasing, but also because the age of patients is decreasing. We are seeing paediatric IBD in clinics, with patients as young as five or ten, not just teenagers or adults. The disease's cause is not easily pinpointed; it's a multifaceted issue influenced by factors like stress and nutrition, and it can emerge suddenly in a person's life with no prior genetic background. This is a major concern because it affects a wide range of people at various points in their lives.

Treating IBD is challenging because most treatments are not effective for all patients; it's often a process of trial and error. I call it "Russian roulette." The disease also has phases of acute inflammation followed by remission. Remission is a crucial time because the disease is less active, and patients can have a more "normal" life. However, they never know when the next acute phase will begin, which is a significant emotional and psychological burden. For kids, it can mean missing school, and for adults, it can affect their work and social life. It's not just about the physical pain; it's a social and psychological issue that also creates an economic burden on health systems due to expensive therapies. In some cases, patients must undergo surgery to remove parts of their gut, which is a tremendous life-altering event. We need to think about IBD in a more holistic way – how to prevent its onset or, at the very least, how to manage and extend remission times so patients can enjoy their lives for longer.

Why did Algae4IBD choose to focus on algae and cyanobacteria in the search for new treatments?

This all started when I returned from my post-doctoral fellowship in the US to establish my lab in Israel. My first master's student approached me with this idea. Coming from a background in drug development, I was intrigued. We began looking into algae and their extracts and saw phenomenal results regarding the immune system.

When the European Commission launched a general call for consortiums to address small molecules for various applications, I saw an opportunity to scale up our mini-project. I wanted to focus on an unmet need like IBD.

Once I saw the results from the algae, I realized it was a huge, still-unexplored treasure. It was a chance to move in two directions: to expand the knowledge of the algae field and industry and to find a novel approach that could help end-users, both in preventing diseases and supporting patients who already have them. We, the partners in the consortium, all feel we have a vast, unexplored resource. If we can use this project to add to this knowledge, perhaps by creating a functional food or a base for a new drug, it will be a good starting point for the European community addressing challenges like chronic diseases.

You've tested various compounds in vitro, in vivo, and ex vivo – what have been some of the most promising results so far?

We took a "funnel approach" to our screening. We created the Algae4IBD bank with 150 different strains from over 100 species. We produced over 600 extracts and we screened all of them in different biological platforms and have seen very promising results for anti-inflammatory, antioxidant, and even novel prebiotic and antibiotic properties.
We approached the disease holistically. A simplified view of IBD involves inflammation, an unbalanced microbiome, and oxidative stress.

Our screening showed that some compounds worked on specific aspects, while others had very high potential for working on multiple aspects. We've now moved on to in vivo models mimicking the disease and ex vivo IBD patient-based assays, and the results are positive. We've narrowed down the most promising compounds to a group of about 20. In our in vivo models that mimic the disease, some of these compounds have already shown good potential for reducing disease markers.

Several prototype products have been developed using these compounds, including yogurt, gummy bears, and pesto. How were these selected, and what kind of feedback have you received?

I like this question because it touches on how we structured the project. We considered the wide range of IBD patients, from a very young age to the elderly. We wanted to create functional foods that could be used daily, not just as a premium product. I thought about my own kids and how I could get them to eat healthily without feeling forced. Products like bread, yogurt, spreads, and gummy bears can appeal to the entire population. We chose

gummy bears with kids in mind, to persuade them to try a functional alternative. Yogurt and bread is in most households today, making it a logical choice. We also needed a variety of products because not every extract works well in every food product. By creating different products, we can match the relevant extracts while preserving their activity. We also have to make sure the food looks nice and doesn't taste or smell strange, like fish.

We tested our prototypes at a summer school in Portugal last year, and they were a huge hit. We made fairy cakes, gummy bears, and pesto. The participants, even the invited lecturers, said they didn't feel a difference in taste and some even said our products tasted better than the originals. We will use a professional tasting panel, and then we hope to get more feedback from a larger consumer assessment at our final event.

With the project nearing its end, what are the key steps left to complete, and what do you hope to achieve by the final stage?

We've already collected and cultivated 150 strains, creating over 600 extracts. All of them have been screened in our in vitro tests. We've now selected the 20 most promising ones, and they are currently undergoing testing in our in vivo models for both colitis and Crohn's disease. We have preliminary results that show some of them are working and could prevent symptoms associated with the disease.

We've also structured our biobank into two groups: Group A, which includes 20 strains that are either known or industrial, and Group B, which consists of 130 strains that have never been studied before. By including both, we can later demonstrate to regulatory bodies like EFSA that new algae can enter the market, benefiting both the industry and consumers.

In the final stages, we have parallel work streams: the animal models and patient assessments based on biopsies. We're trying to correlate the results from both. In parallel, we're preparing our food products with all the recipes and protocols for our final event. We're excited because we'll be showcasing products like our fairy cakes, pesto, and gummy bears that have already been validated for their activity. This is the most exciting stage for us, and we're seeing the results and the products come together.

What role do you see these products playing in the future management or prevention of IBD?

Could they become part of mainstream treatment plans? We are approaching this in two ways. First, we are trying to identify a pure compound from the most promising strains. While this is a longer-term effort, we hope to at least have the compound structure by the end of the project, which can then be developed further by pharmaceutical companies.

I wouldn't say these products will be a cure or a complete replacement for current treatments, but I truly believe they can serve as a supportive treatment. In the last decade, clinicians have become more aware of how functional nutrition and food supplements can assist standard care. This is a holistic approach aimed at making the

body stronger on multiple levels—the immune system and the microbiome. I hope these products can help extend remission times and make patients less dependent on other therapies, allowing them to feel like they can have a normal life. This would be a huge achievement in my opinion.

With your final conference coming up in Ireland, what can participants expect, and will they have a chance to try any of the products?

Yes, a big “yes!” The major point of the event is to showcase our products. We want to bring together a diverse group of stakeholders, including the food industry, patients and their families, clinicians, and consumers.

Today’s consumers in Europe are more aware of what they’re eating and want more from their food than just proteins, fibers, or carbs. They want products that can help them maintain their health. We want people to come, try the products, and give us feedback on the sensory experience and whether they would want to incorporate them into their daily eating habits. We also need to consider the cost of these products, as algae-based ingredients are still more expensive than, for example, soybeans or wheat. We need to find the right balance.

As an applied scientist, my goal is not just about the economic side; I want these products to reach the market so people can benefit from them. I think we still have a bit of a long way to go, but we want the participants to not only learn about our results but also to be part of our experiment by providing valuable feedback.

Final thoughts

We hope regulatory bodies like EFSA will understand the value of projects like this and take our results into consideration when deciding which novel foods can enter the market. We hope to see them at our final event to convince them. Secondly, European commission funds such as those invested in the Algae4IBD project are highly valuable for bringing innovation and making a difference. We hope to see more of these EU opportunities in the future in order to continue our research.
Project

Algae4IBD

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