

CODIF TURNS A NEW PAGE IN THE HISTORY OF PHOTO- BIOREACTOR ALGAE CULTURE

In 2006 Codif Technologie Naturelle (CODIF TN) collected a 1-milligram fragment of a calcified macroalgae, *Jania rubens*. In 2022 the company passed the milestone of 1 tonne of dry matter produced since then. *Jania's* pompon has become the symbol of the company. Its culture and history are the best example of Codif's work and approach to CSR.

Follow the story with Eric Gasparotto, Manager of the Industrial Innovation and Implementation Department and Romuald Vallee, Director of Codif TN.

Eric GASPAROTTO



Romuald VALLEE



THE BEGINNING OF THE «JANIA RUBENS» PROJECT

Hello both of you. Could you tell us how the whole thing started?

Romuald VALLÉE : Everything started in 2006 when we decided to take on a student to write a thesis on “Developing a cellular culture of *Jania rubens*”. The student was Eric. *Jania rubens* is a macroalgae with incredible properties, but it is slow-growing and there is a significant risk of overexploiting it. So we considered a simple question: how can we grow the algae without having a negative impact on nature? That’s where science and research came in.

Eric Gasparotto : e looked at several possibilities. We had to do a number of trials before finally deciding on growing it in a photo-bioreactor. That initial stage alone took a lot of research time.

THE JOURNEY THAT LED TO SUCCESS

What were the different steps involved in bringing the project to fruition?

E.G. : We did everything bit by bit because there was very little culturing of macroalgae in photo-bioreactors at the time and nothing on a large scale. So there was no data available. We had to try several things.

The initial approach we tried was a cellular culture, using protoplasts . We had to separate the cells from their cell wall. We succeeded in doing this but the next step was a problem. Once the cells had been separated from their cell wall you had to make them divide to start culturing them. We did not succeed in being able to achieve that. That made us look at another approach: photo-bioreactor culture which we were experienced in using to grow microalgae. Therefore, we adapted and developed the process until we obtained the first culture of a calcified macroalgae in a photo-bioreactor. As far as we know we were the first to succeed with this type of culture and it is still completely unique today.

R.V. : Once the culturing process had been thoroughly developed, we started industrial production of *Jania* in 2012. We started with the largest photo-bioreactors available on the market, which were 250 litres. But we soon found that was too small. So, we had custom made tanks manufactured to increase our capacity to 500 l and then 750 l. But at a certain point it wasn’t possible to increase the size of the tanks further due to logistical constraints. Therefore, we have had to use more reactors and invest in a larger biotechnology hall. Our algae culture technology continues to develop and improve continuously.



E.G. : The algae hides a lot of surprises and still remains a challenge for our research teams. Despite the increase in production, there are still a lot of unknowns. There are so many factors that can influence the culture. We see that optimising one factor achieves nothing if another factor isn't optimised at the same time. We found this out when we were working on algae metabolic orientation protocols to make it secrete compounds we were interested in.

The best example is the production of taurine by *Jania*. When we started we obtained variable taurine levels, with an average of 900 to 1000 mg of taurine per dry kilo of *Jania* (ppm). It was learning to control several culturing parameters that enabled us to increase that to more than 1500 ppm in a consistent manner. The main factors that were changed were the nitrogen input, the amount and temperature of the air entering the culture tanks and the quality of drying, which has to be performed quickly.

This year marks an important milestone in your cultivation of Jania. Can you tell us more?

E.G. : This year, after 10 years of industrial production, we reached a total of 1 tonne of dry matter produced. That tonne was produced from a single purified fragment which has been multiplied and which we use as the strain to seed all our cultures. The fragment weighs about 1 milligram dry. It's quite interesting to look at the multiplication factor. We have gone from 1 milligram to 1 billion milligrams.

R.V. : In my view, the result obtained after 10 years as well as the *Jania* culture that we have established is the best example of Codif's CSR approach. We collected the strain, purified it and have not had to touch Nature since. That's important. We can leave the algae alone in its natural environment surrounded by other algae and sea creatures.

Since we were established, we have tried to produce innovative actives while staying true to our environmental values. We call this Bioth-Ecology: using high value-added biotechnology to cultivate plants and algae which are identical to those in the natural environment. For us Bioth-Ecology cultivation represents the ecology of the future and enables us to "copy and paste" from the living world without affecting the resource ecosystem that we are using. In this culture method, the specific conditions of life that correspond to the organism's natural habitat are recreated. That's what we have done with the culture of *Jania rubens*.



NEW CHALLENGES PRESENT THEMSELVES

And today, what are the future challenges for culturing algae in a photo-bioreactor?

E.G. : For us, the next step is to automate our culture methods. Currently, culturing requires a lot of human intervention. This is becoming more and more difficult for our production personnel. We have 48 culture tanks and they have to perform operations on each one twice a day. In parallel demand continues to grow and so production has to increase as well.



R.V. : This means we have asked a company to develop a process control system to accurately control the inputs. The results will be assessed for 6 to 8 months before approving implementation. Given that culturing takes a long time, we have to ensure good results can be achieved consistently before applying an automated control system to all our tanks.

E.G. : In parallel with automation, we are also working on the lighting conditions for the culture. Changing to LED lighting greatly reduces energy consumption. But once again, simply changing the lighting

has an effect on productivity that cannot be ignored and has required us to modify our culture protocol. We are also working on improving our use of air. The configuration of our tanks means we have to supply them with a large amount of compressed air. This is the most energy intensive input. Therefore, it's a priority for optimisation.

AND NOW WHAT ARE THE PLANS?

Are there any other projects like this at CTN?

R.V. : As I said we are continuously looking to implement culture methods that have as small an environmental impact as possible.

This year in 2022 for instance we launched a new active called Vitasmoothy. It is derived from de-differentiated cells. This is a first for Codif TN! Our entire production of Vitasmoothy comes from a few pieces of lavender leaf.

E.G. : This culture also made us design and develop our own industrial culture tanks to get away from the plastic containers that are generally used for culturing plant cells in a liquid medium. Without revealing how we make them, we now only work with washable and re-usable containers. We have saved 72 plastic culture bags for every one hundred kilograms of active manufactured.

R.V. : Our search for a way to produce high quality active ingredients in an environmentally friendly way started a long time ago. And we do not plan on stopping now that we have made so much progress.

