

NEXTGEN

PROTEINS

Bioconversion of Underutilized Resources into Next Generation Proteins for Food and Feed

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1 Executive Summary

This report gives an overview of the status of NextGenProteins at the end of the third year (36M). The report is based on the contributions given by various partners at the 3rd Annual Meeting, which was held in Bologna, Italy during 6th and 7th of October 2022. For further details on the status of the project we refer to the attached presentations given at the meeting as well as the Technical report (RP2) submitted at 36M.

The first day at the 3rd Annual meeting was dedicated to presentations on the status of individual work-packages (WP1-WP9). Further, a specific session was held on communication and dissemination, to communicate effectively the sustainability of alternative proteins with specific focus on discussion on how to impact Policy and Regulations. Additionally, a stakeholder session was held together with invited stakeholders from sister projects, to reflect on their results and support possible collaboration. The second day at the 3rd Annual Meeting was dedicated to an Exploitation Workshop with focus on exploitation and commercial use of the developed NextGenProteins innovations. Further, a specific presentation was held on “Responsible Research and Innovation” (RRI).

Status of NextGenProteins. Work in all WPs has been initiated. Overall, it can be stated that NextGenProteins is on a good track in reaching all the specific objectives that we set out to achieve, 36 months ago. During this 3rd project year (M25-M36), all milestones were reached on time, except for MS12 originally due in M32 but reached in M34. All deliverables were delivered on time, except D6.3, due in M32 but submitted in M34.

Although the Covid-19 pandemic affected our lives strongly, closed off labs and caused that we could not work except from home, if lucky, it did not lead to delays in outputs from NextGenProteins to any large degree. We could not travel or hold any physical meetings which meant that all communication had to be done remotely, online, via email, telephone or by TEAMS. All issues related to the pandemic that came up were handled within the Consortium in such a way that it did not affect the implementation of the DoA to a significant degree. The work is now progressing as planned and the project partners are moving forward to fulfil the project objectives and the overall aim of optimising the production of three alternative proteins – microalgae, single cell and insect protein - and demonstrating their use in various feed and food applications, in order to meet customers’ needs and ensure consumer acceptance.

Status of work in individual Work-packages.

WP1 has delivered reports on the EU regulatory landscape for production and use of alternative proteins in both food and feed. Progress is ongoing on task 1.2 “Policy contributions” and task 1.3 “Pre-market approval for the three NextGen proteins”. However, it is uncertain if task 1.3 will be implemented, as the protein producers within the project have so far not indicated the need for such an approval. The paper “Regulatory challenges of alternative proteins” was presented at a collaborative webinar of the “sister” project

SUSINCHAIN and NextGenProteins in December 2021 on “Safety & regulations for novel protein sources”. Work towards delivering D1.3 Policy recommendations due in M42 is ongoing.

In *WP2* work is ongoing on “Alternative protein production” (task 2.2) and “Process and Post-process optimisation” (task 2.3). RISE Processum has delivered over 35 kg of Single Cell Protein for testing and trials. ARBIOM has supplied, during period 25-36M, about 3200 kg of single cell product to other partners for testing and trial work. VAXA has supplied about 1200g of Green Spirulina for testing in other WPs. MUTATEC has supplied 7200 kg of insect meal for trial work in *WP4*. Some improvements of the functional properties of the alternative protein products have been achieved. VAXA has now four Spirulina products: Green, Blue, White and the biomass. Within *WP2*, various presentations have been given at conferences and events during this third year of the project. One peer reviewed article on environmental impacts of large-scale spirulina production has been published, one MSc and one BSc thesis defended based on work conducted within this WP.

In *WP3*, work is ongoing in all tasks: “Ready meals” (task 3.1), “Bakery products (task 3.2), “Imitation meat” (task 3.3) and “Functional food supplements” (task 3.4). The focus in all tasks in this third year has been on final steps of product development and finalisation of product prototypes containing the NextGenProteins protein ingredients, for stability and consumer testing. Within task 3.1, two types of ready meals were developed. One type was vegetarian cakes with date filling, and the other vegetarian cakes with spinach filling. Each contained either Spirulina or Torula, and the goal of increasing the protein kcal/total kcal above 12% was reached. After final selection and preparation of products the stability of products will be tested early in the 4th project year as well as carrying out consumer testing. Within task 3.2, two types of bakery products were developed. One type was bread crisp slices containing either Spirulina or Crickets, and the other extruded snacks containing Crickets. By the end of the third project year, both stability and consumer testing were started. Within task 3.3, two types of imitation meat products were developed. One type was sausages and the other burgers. Each contained Torula. Stability and consumer testing are planned in the beginning of the 4th project year. Within task 3.4, four types of advanced functional food supplements were developed: Gelled bread with Crickets, powders for spreads with Torula, dip and smoothie-bowl with Spirulina. Consumer testing of spreads and gelled bread is planned early in the 4th project year. Main challenges within *WP3* were due to Covid-19 restrictions and the regulatory environment as well as overcoming sensory and functionality issues related to the protein ingredients, but none did significantly affect the progress within tasks. Within *WP3*, various presentations have been given at conferences and events and one MSc thesis was defended based on work conducted within *WP3*.

WP4 has delivered two reports on feed formulation and processing (D 4.1 and D4.2) within task 4.1 Feed formulation and processing. This task was completed within this project year. Work in “Dose-response and field trials, terrestrial” (task 4.2) and aquatic animals” (task 4.3) and in “Health, welfare and physiological indicators of animals in dose-response trials” (task 4.4) is ongoing. Within these tasks, lab scale trials have been completed, and optimal inclusion levels have been identified for the target species. Some analysis and data processing are still

in progress. Field trials have either finished or are close to finalisation. Inclusion of the alternative protein sources in partial substitution at high dosages affected growth performance of chickens, especially during first weeks of life. This could be related either to palatability or digestibility of the alternative protein sources, if supplied at high dosages. The use of pellet diets and enzymes could represent potential solutions to overcome such limitations. The ongoing metabolomic and microbiota insights could reveal underlying effects associated to the performance impairment. Work from WP4 has been widely disseminated during this third project year, by presentations at conferences and events. In addition, one BSc thesis based on WP4 work has been defended and four manuscripts are under preparation or are in the process of submitting to peer reviewed journals.

In *WP 5*, work in all tasks was ongoing towards establishing market potential for food and feed products containing the alternative proteins, identifying suitable approaches to boost consumer trust and acceptability towards the three alternative protein sources and processes and to create business models for the three alternative proteins as ingredients in food and feed. Within “Market opportunities for novel products containing alternative proteins” (task 5.1), and “Boosting consumer trust and acceptability towards alternative proteins” (task 5.2), more in-depth analysis of collected and additional data, e.g. from Twitter is ongoing. Although the overall principle of NextGenProteins alternative proteins were valued; the boosting of consumer acceptance and trust is of high importance. Publications are being prepared based on the results. Within “Business models for alternative proteins” (task 5.3), discussions with NextGenProteins industrial partners have continued, to update and enrich their business plans. Results from WP5 have been disseminated at conferences during the third project year, and a manuscript is in preparation for submission for a peer-review journal.

WP6 has delivered three reports: Report on economic impacts shifting protein production to NextGenProteins alternative proteins (D6.2), Report on circular economy potentials of the alternative proteins production process (D6.3), and Report on value chain risk assessment (D6.4). As for the economic potentials, the combined production of the four NextGenProteins alternative protein producers could be 15-20,000 tons and total employment associated with the production of 150-200, in the not-too-distant future. Neither the level of production nor employment is likely to have but a very minor impact on the market for proteins and employment in general, but the importance of the producers could be quite large at a local or even regional level. Additionally, the alternative proteins have the potential to reduce the environmental impacts from traditional protein production when compared to proteins which have a high environmental impact. Although the four companies have all developed technology to produce alternative proteins, the production and processing differ, and some identified risks are company-specific. Two sets of risks are common to all the four industry partners: 1) the risk of being unable to attract funding and 2) the willingness of consumers to accept the new, alternative proteins. The latter is minor regarding animal feed. Both may be mitigated by better marketing, more information and greater transparency. A presentation based on WP6 was given at a webinar on circular economy potential for alternative proteins.

In *WP7* all tasks are ongoing in engaging with stakeholders both within the food and feed sectors, policy makers and consumers, via interviews, co-creation, at exhibitions, workshops

and conferences. Communication and dissemination have been active, off-line and online. The data management plan (previously submitted as D7.6 in M06) was updated in M18. We had planned to re-submit the deliverable at M36 with the technical report but as yet the deliverable has not been re-opened by the Commission. Specific emphasis was placed on communication and dissemination in terms of communicating sustainability of alternative proteins with focus on discussion on how to impact Regulation. The RRI was reiterated by all WPs following the RRI strategy during the 3rd project year. A specific session at the 3rd Annual Meeting was devoted to Responsible Research and Innovation (RRI), to reflect on the process and framework previously used by the consortium towards and beyond RRI Gates 2 and 3. Focus was placed on anticipating & analysing, reflecting & reasoning in regard to the process and the product, engaging & including, acting & responding in regard to the purpose and people.

In *WP8* work is ongoing on all tasks (tasks 8.1-8.4). The beneficiaries initiated an amendment process (5th of November 2021) covering transfer of funds from Fazer to RISE, removing Fazer bageri as linked third party to Fazer, Peas of Heaven to become linked third party to Härryda Karlson, and KPMG becoming a beneficiary, following KPMG takeover of Circular solutions. The amendment was accepted by the Commission on June 7th, 2022. At the end of 36M the partners in the consortium had claimed about 64% of the total expected cost, or €5,955,582. Work has been initiated in all WPs and approximately 72% of the overall effort had been used at the end of 36M.

In *WP9*, all deliverables were submitted in the first project year. Drafts of forms to be used for the different situations regarding human recruitments and animal trials as well as data protection were prepared and uploaded on the internal area of NextGenProteins. All participants were asked to send in information regarding their Data Protection Officers and for beneficiaries not required to appoint a DPO under the EU General Data Protection Regulation (GDPR) have made a detailed data protection policy for the project. Their conformation as well as a list of DPO were included as an Appendix in deliverable 9.2. During the 24M Annual Meeting that was held Online the 2nd and 3rd of November 2021 all participants were reminded of the Ethical requirements that need to be followed and reminded where the relevant documents could be found on the internal site of NextGenProteins.

The stakeholder session included presentations from sister projects. Maria Garcia Torreiro (from Smart Protein Project) presented the project, objectives and results with focus on fungi fermentation and Laura Gasco (from SUSINCHAIN) introduced their objectives, main tasks and presented results of their valuable work on using insects as ingredients in feed for the European market. Insights and discussions among the sister projects are valuable for synergies and future collaboration.

In the exploitation workshop, the main exploitable outcomes from NextGenProteins were presented and potential joint business interests between industry partners in different stages of the food and feed value chains discussed. From *WP3*, industry partners presented part of the product development results, partly as tasting sessions (Figure 1).

Most NextGenProteins industry partners expressed interest in exploitation of project results, and project products, in future collaboration with NextGenProteins partners. Main synergistic effects were seen within WP2, WP3 and WP4 collaboration, with use of results from WP1, WP5 and WP6. Some concerns were raised regarding cost of production of sustainable alternative proteins, as currently, non-sustainable proteins can be produced without any restrictions or taxes due to CO₂ emissions.



Figure 1. Food products containing NextGenProteins alternative proteins presented at the 3rd Annual Meeting, Bologna, Italy, 7th of October 2022.