

Nutreco Feed Tech Challenge 2018 Proposal

NatuAXTM - Novel combination of β -Glucan and Astaxanthin from unique
high-yield strain of *Phaffia rhodozyma* to disrupt the use of antibiotics in
livestock and aquaculture



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Describe the problem your company wishes to solve and how your product or service will solve it

Summary of the project

During our process of developing an innovative and comprehensive bioprocess to produce astaxanthin in *Phaffia rhodozyma*, we found that our novel high-producer strain could also produce β -glucan at levels much higher than other yeasts. Conscious of this finding, we designed a *state-of-the-art* formulation to make highly bioavailable both compounds β -glucan and astaxanthin, creating so NatuAX™. Due to its unique health-promoting properties and particularities, we believe that NatuAX™ will boost the immune system in feed-producing animals, disrupting thus the use of antibiotics in the livestock and aquaculture industries. Techno-Economic analyses suggest a commercially viable process.

Detail description of the project

The use of human-medicine antibiotics in feed-producing animals continue raising a global health concern in our society due to the latent threat of developing antibiotic-resistance bacteria (AMR). A recent estimate suggests that, by 2050, 10 million people will die every year due to AMR, unless global actions are taken [1]. To avoid this risk, a well-functioning immune system in animals is critical to abstain from using antibiotics. Therefore, the potential of different natural compounds to strengthen the immune system in animals has been subject of extensive investigations. Here in Bioproton, a company emphasised to provide supplements for the animal feed industry, we are aware of the latent risk of using antibiotics as growth promoters in animals, so we are constantly looking for natural antimicrobial alternatives.

β -glucan is a natural component of yeast and fungi cell walls. This compound forms part of the yeast cell wall extracts widely used as prebiotics due to their known immune modulating effects [2]. These extracts are potential replacements for dietary sub-therapeutic antibiotics commonly used in animals. Supported by more than 6000 scientific publications, the main immunomodulant component of the yeast cell wall extracts is β -glucan [3–6]. On the other hand, astaxanthin (AX) is a xanthophyll that displays a remarkable red-colouring, antioxidative, and health promoting properties. AX is naturally-occurring in salmonids, shrimp, krill, and some crustaceans. This pigment is responsible for the characteristic pink-colour on these aquatic animals. As these animals cannot synthesize astaxanthin *de-novo*, when aqua-cultivated, AX needs to be supplemented in their diet. Due to its potent antioxidant and immune-system stimulant properties, AX finds also uses in the human-medicine industry as nutraceuticals, and in the broiler and swine industries as feed additives. Although β -glucan or AX have been used as immune system stimulants, there are no reports of the effect of using a combination of these compounds.

Currently, the main source of AX comes from petrochemical processes. In our laboratory, conscious of the issues associated with the unsustainable and synthetic production of AX, we developed an innovative and comprehensive bioprocess to produce high yields of astaxanthin in *Phaffia rhodozyma*. Surprisingly, during our study, we found that our novel high-producer strain of *Phaffia rhodozyma* was able to produce β -glucan, a component of its cell wall, at levels much higher than other yeasts and strains of *Phaffia rhodozyma*. Moreover, the high level of β -glucan (β (1,3)-glucans, β (1,6)-glucans) produced by our novel strain has an increased structural function and better molecular properties compared to the ones present in other organisms. Conscious of these particularities, we further developed a *state-of-the-art* formulation method to simultaneously deliver β -glucan and AX with significantly enhanced bioavailability. The particularities of our novel strain and product formulation were incorporated in our novel product named NatuAX™. We hypothesize that our

unique high-producer strain of *Phaffia rhodozyma* can synthesize a natural combination of β -glucan and AX that, when properly formulated and dosed, will boost the immune system in animals, disrupting thus the use of human-consumption antibiotics in the animal feed industry.

Economic viability of the project

After our bioprocess and product formulation were developed, we performed a techno-economic analyses of producing NatuAX™ at industrial scales. We used energy and mass balances to determine economic viability of using our novel strain of *Phaffia rhodozyma* to produce NatuAX™. The analyses suggest that our high-producer strain is able to produce β -glucan and AX in a sustainable and commercially viable scheme. The particularities of our novel strain and product formulation allowed to meet commercial viability. Our unique strain is able to have high yields and growth rates on cheap carbon sources including sucrose, glycerol, molasses, xylose, or corn steep liquor. Similarly, the methodology for formulation is based on low-energy processes and economic raw materials.

Describe other business assistance that you are seeking from Nutreco

We have a strain of *Phaffia rhodozyma* be able to produce high yields of astaxanthin and remarkable levels of β -glucan. Considering these particularities, we developed a *state-of-the-art* method to make both compounds bioavailable. However, we have not tested our novel product *in-vivo*. We seek support from Nutreco to perform animal trials – aquaculture and livestock industries – to measure the effects of our NatuAX product as potential replacement of antibiotics in the animal feed industry.

Are you available to participate in the final event in the Netherlands 28, 29, and 30 May ?

Yes

Describe how the prize – a validation trial in our facilities – could boost the development of your business

We have validated our NatuAX™ product *in-vitro*, showing promising results. However, we still need to validate our results *in-vivo*. The *in-vivo* validation of our novel NatuAX™ product at Nutreco will provide critical data to evaluate its effectiveness. The validation data will be also used to define the marketing strategy before launching NatuAX™ into the marketplace.

References

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