



Łódź, January 13, 2025

Evaluation of the dissertation for the doctoral degree in the field of exact and natural sciences in the discipline of biological sciences for Katarzyna Pacyga-Prus, MSc, entitled:

„Biological activity of *Bifidobacterium animalis* ssp. *animalis* CCDM 218 and *Bifidobacterium adolescentis* CCDM 368 surface antigens in complex interactions with the host organism – prevention/treatment of allergy diseases”

performed in

the Laboratory of Microbiome Immunology at the Institute of Immunology and Experimental Therapy of the Polish Academy of Sciences

under the supervision of Sabina Górńska, PhD, Associate Professor at HIIET PAS

Allergic diseases are the most common health issues in developed countries. A microbiome is suspected to play a crucial role in the proper lifespan shaping of the immune system and the development of allergic disorders in the pathological conditions. Considering the great complexity of microbiome - immune system interactions, little is known about the effect of microbiota on the immunopathology of allergic inflammation. Therefore, Katarzyna Pacyga-Prus, MSc, decided to assess the role of surface antigens of *Bifidobacterium animalis* ssp. *animalis* CCDM 218 and *Bifidobacterium adolescentis* CCDM 368 on the immunopathology of allergic inflammation.

Assessment of the structure and substantive content of the dissertation

The dissertation presented for the review has a modern, contemporary layout and is a very carefully prepared typescript of 151 pages, supplemented with 2 original manuscripts published in high IF journal and one preprint. Additionally, it contains a list of participation in research projects, conferences, courses, internships, and science promoting events as well as awards, co-authored publications, and series of declaration of co-authors.

The following papers are included into the Dissertation:

1. Pacyga-Prus K, Jakubczyk D, Sandström C, Šrůtková D, Pyclik MJ, Leszczyńska K, Ciekot J, Razim A, Schwarzer M, Górská S. Polysaccharide BAP1 of *Bifidobacterium adolescentis* CCDM 368 is a biologically active molecule with immunomodulatory properties. *Carbohydr Polym.* 2023 Sep 1;315:120980. doi: 10.1016/j.carbpol.2023.120980
2. Pacyga-Prus K, Sandström C, Šrůtková D, Schwarzer M, Górská S. Phosphorylation-dependent immunomodulatory properties of B.PAT polysaccharide isolated from *Bifidobacterium animalis* ssp. *animalis* CCDM 218. *Carbohydr Polym.* 2024 Nov 15;344:122518. doi: 10.1016/j.carbpol.2024.122518.
3. Pacyga-Prus K, Hornikova T, Šrůtková D, Leszczyńska-Nowak K, Zabłocka A, Schwarzer M, Górská S Polysaccharide BAP1 of *Bifidobacterium adolescentis* CCDM 368 attenuates ovalbumin-induced allergy through inhibition of Th2 immunity in mice (preprint)

In the *Introduction*, Katarzyna Pacyga-Prus, MSc, makes a brief characterization of immunopathology of allergy concentrating on epithelial damage that leads to the development of T2 inflammatory responses. Author defines the importance of microbiota dysbiosis in allergy. Finally, Author describes a potential role of *Bifidobacterium* strains and postbiotics in the allergic inflammation. Thus, this chapter prepares a good ground for understanding the numerous substantive aspects contained in the work and publications. The assumptions and goals of the work are formulated correctly.

Each publication is preceded by a short description of the rationale, methodology and results and is crowned with a short conclusion. This arrangement of the text greatly facilitates the understanding of the results discussed in the publications and in the entire dissertation.

In the first paper, it is observed that BAP1 isolated from the surface of the Bad368 strain is an antigen of high molecular mass and unique structure. It is shown to exhibit a potential to alleviate allergic conditions by restoring the balance between T1 and T2-related cytokines. In the second paper, Author described that the modification in the PS structure may change the immunomodulatory properties of the molecule. Dephosphorylation of B.PAT resulting in the structural changes of the molecule causes changes in its the immunomodulatory properties favouring B.MAT's ability to induce cytokine response and prevent IL-1 β inflammatory response. In the third manuscript, Author proved that BAP1 demonstrated anti-

allergic properties in OVA-induced allergic airway inflammation. It causes a systemic reduction of OVA-specific IgE concentrations, it restricts lung inflammatory response (lower eosinophil infiltration and IL-4,5,13 production). Author concludes that this molecule may have a potential do serve as an alternative treatment for airway allergies.

Despite the great value of the dissertation, I have several comments:

1. Author uses the phrase: “Th2” type inflammation. Currently, the phrase “T2” is being used as type 2 inflammation refers not only to Th2 cells, but also to ILC2 cells;
2. Author uses the phrase: “allergy diseases”. It should be “allergic diseases”;
3. Author uses the phrase: “OVA-allergy mouse model”. It should be: „the mouse model of OVA-induced allergic aiway inflammation”;
4. There is a lack of bibliometric parameters of journals in which papers are published.

It should be emphasized that Katarzyna Pacyga-Prus, MSc, used a large number of complex research methods to achieve her goals. She obtained a great amount of results. Knowledge of a wide range of methods proves the versatility and methodological skills of Katarzyna Pacyga-Prus, MSc, and her excellent readiness for the implementation of the research tasks. The ability to analyse and interpret the results obtained using these methods indicates the dynamic scientific development of the PhD student that took place during the implementation of the research and the extensive experience that will probably pay off in the near future. The results were analysed using properly selected statistical methods.

It should be emphasised that research presented it this dissertation was carried out and financed by National Science Centre (Sonata Bis 7, UMO-2017/26/E/NZ7/01202) and NAWA Polish National Agency for Academic Exchange (MOBILITY, PPN/BIL/2018/1/00005).

Summary

The doctoral dissertation presented for review is a reliable, valuable, original and independent scientific study of aspects concerning the potential relevance of *Bifidobacterium*-derived surface antigens for the alleviation of allergic inflammation. Katarzyna Pacyga-Prus, MSc, undertook an ambitious task - she properly planned the work, substantiated the substantive basis of the conducted research, properly formulated and implemented research goals, and drew a number of interesting conclusions from obtained results. The dissertation is a good example

of a conceptual approach to a selected scientific problem. An important value of the dissertation is that it is one of the few studies on the subject chosen for research. The work makes an contribution to the existing knowledge in the researched field.

Therefore, I believe that the doctoral dissertation meets the conditions specified in art. 187 sec. 1-4 of the Law on Higher Education and Science (Journal of Laws 2023 item 742 with subsequent amendments).

I hereby submit to the Scientific Council of the Institute of Immunology and Experimental Therapy of the Polish Academy of Sciences a request for admission of Katarzyna Pacyga-Prus, MSc, for further stages of the doctoral thesis.

Taking into account the very high value of the dissertation, the use of novel research methods, and the performance of an in-depth, critical analysis of the outlined topic, as well as the unique dimension of the research obtained, I request the Council to recognize the doctoral dissertation of Katarzyna Pacyga-Prus, MSc, as outstanding and accept it with distinction.

Dr hab. n med. Maciej Chałubiński, prof. UMed w Łodzi



Signed by /
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