

To
The PhD examination board of the
Gdansk University of Technology

Fermoy, 19 February 2026

Examiner's report of the submitted PhD dissertation entitled "Characterization of bioactive peptides from chicken feather keratin and products of their transformations occurring during the Maillard reaction" by Antoni Taraszkiewicz, Gdansk University of Technology

The submitted PhD thesis of Mr Antoni Taraszkiewicz covers the area of adding value to waste streams in particular from chicken feathers. The candidate proposed to extract keratin from chicken feathers, and further process it by common methods of food technology for use functional food ingredients.

The thesis was planned in a highly logical and methodical way: an extensive overview of the existing literature and scientific background followed by four research chapters and another review chapter. These were compiled in a scientific paper format, either as MS Word or journal format. Four out of the five papers are already published in peer-reviewed journals, a fifth manuscript is currently under review, however the PhD candidate only contributed to the latter manuscript rather than being the lead author. The papers are published in the high impact journals such as *Critical Reviews in Food Science and Nutrition* and *Food Chemistry*. There seem to be other published papers related to the subject matter, however, these were not included in the PhD submission.

The thesis has been compiled and written to a very high scientific standard; all chapters were written in English. The results of each chapter/paper are well discussed and appropriate conclusions drawn. The topic and outcome of this PhD thesis may be of significant interest to academia and industry, in particular to producers of feathers e.g. poultry producers and the poultry industry as a whole.

The results of the thesis provides a good scientific basis to proceed to the next stage e.g. feasibility study and possible exploitation of the concept etc. However, it will require both considerable effort and resources to test such a process on a large and commercially viable scale.

Overall, it is a very good PhD thesis and I, as an external examiner, would have no hesitation in recommending that the PhD candidate can progress to the next stage of the PhD examination process.



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Scientific Review

It was noted that the project spanned several subject matters and can be considered multi-disciplinary, which brings along a demanding, labour-intensive work schedule and requires a multi-skilled PhD candidate supported by an array of research and technical staff. Projects of this nature also bear considerable risk as all the work needs to be finished within a tight, time-constrained PhD program.

The chosen substrate for the project was a challenging waste product from the animal production. Working with products that are generally treated as waste bring their own challenges in terms of quality and consistency. It is obvious from the PhD thesis that a lot of thought went into the structure of the project, with a good supervisory and technical support.

The PhD candidate also reached out for an opportunity to experience another research environment, here in our own research institute in Teagasc. This chapter 5 required a completely different expertise of molecular biology and cell culture work; these results significantly added to the overall quality of the submitted thesis.

Chapter 1 is a comprehensive overview and introduction of the area. Some of the figures are excellent and novel. The chapter ended with a *Research Part*, which gave a good outline of the aims, hypothesis and scope of the thesis, with a good schematic workflow of the thesis (Fig 11).

The only criticism would be the generous use of very recent citation rather than original papers, for example p. 32, cyst content of keratins. I am pretty sure this has been known for much longer than 2011.

Paper 1 covers an *in silico* approach to proteolysis, to both chicken feather and pig hair keratin. The chapter is fully published. For me the highlight or lesson from this chapter was the emphasis on very short di- or max. tri-peptides. In the past, a lot of work was devoted to demonstrating the bioactivity of unique medium-sized peptides. This was before people realised that peptides can be further gastro-intestinally-digested when administered orally. I also appreciated the approach of ranking and scoring each parent peptide and enzyme.

Paper 2 goes into the wet-chemistry of extraction and enzymatic hydrolysate. Again, the chapter was already peer-reviewed and published in *Food Chemistry*. The paper nicely demonstrates the good solubility of both KI and its hydrolysates. Yields were also quite high depending on the conditions, e.g. urea-free extraction can range from 14 to 88%. The physico-chemical characterisation is sound, and the interpretation of the results was adequate. As a low-point I would see the FTIR section with its lack of detail, both in the experimental description and in the interpretation of the results. However, a more detailed chapter is to follow. In addition, as a reviewer I would point out that figure legend should be self-explanatory, which helps to better understand figures without going back and forward to find abbreviations and conditions etc. It should also be pointed out that the HPLC-SEC results in Fig 1 are for soluble peptides only. In addition, a more broader Mw range would have improved clarity.

Paper 3 is a collaborative chapter with only a small contribution (15%) by the PhD candidate. Again, it should be pointed out that it was not clear how the FTIR samples were measured: ATR, as powder, what crystal and what accessory, single or multiple bounce, which detector (cooled MCT or DTGS), any atmospheric compensation for moisture and CO₂ in the ATR chamber etc. For the secondary structure, why was there no detailed spectral analysis of the *amide I* band performed? Does this make sense for hydrolysates and very small peptides? It was very interesting to see that -SH and S-S could be distinguished. What is the sensitivity of the detect at 517cm⁻¹ and was it sufficient?

Paper 4 deals with the functionality of KI, its hydrolysates and their MRP with glucose and xylose. The functional tests included anti-oxo assays, Fe chelating etc pre- and post-digestion, as well as its reactivity with Caco2 cells and salmonella. The discussion includes a deep-dive into Maillard reaction and its effect on their functionalities.

Paper 5 is a comprehensive review of proline-specific peptidase and their biological role and potential. It highlights the lack of high-quality clinical data available to the scientific community. This review is somewhat disconnected from the rest of the thesis – but that's fine.

Unfortunately, this PhD thesis lack an overall discussion of the thesis or future perspectives: "So what?"- is the question that needs to be asked and answered i.e. an overall conclusion and an opinion of the PhD candidate. However, I will not hold this against the PhD candidate as the structure of these PhD theses are generally governed by the university or the departments. However, I would very much like to see this during the PhD defence.

On a lighter note, it was a pleasure reading the thesis as all results were presented in a very logical and clear manner, and were worthy of a good PhD thesis.