Controlling the nutritional quality of germinating pulses

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ABSTRACT

Pulse consumption is recommended by the FAO as it constitute an alternative to animal proteins. Actually, they need few water and chemical inputs due to their ability to fix atmospheric nitrogen. Despite their qualities, pulses are still underused mainly because they need a long cooking time and because of their content in anti-nutritional factors that may degrade digestive comfort and absorption of minerals. To counterbalance these aspects, germination is gaining interest as this process can increase the nutritional potential of pulses while decreasing anti-nutrient factors. Moreover, this process is natural and sustainable. Unfortunately, germination is rarely conducted at the industrial scale due to the difficulty to understand and therefore adequately control the germination phenomenon and more precisely the mechanisms governing the metabolic behavior of the seed and their modulation according to the germination process parameters.
This project proposal covers the third axis “responsible production and consumption”. It is based on a series of experimental contributions through crosscutting disciplines between food processing optimization (UMR QualiSud and Agronomic Sciences Faculty of Abomey Calavi University, Benin), plant biology and physiology (IJPB) and plant-cell histo-anatomy and imaging (UMR AGAP PHIV platform). By an adequate experimental and modeling strategy, the objective is to identify, localize, and describe the disruption of enzyme activity and biochemistry between the dormancy and the germination state of the pulse. The proposed co-learning approach will allow (i) to improve our knowledge on legume seed germination, (ii) to develop an original approach combining several imaging techniques to localize enzyme and substrates within the seed during germination, (iii) to elucidate how the germination process can be optimized to improve the nutritional quality of pulses and (iv) to define an easy-to-implement germination protocol allowing optimized nutritional quality. The work will be divided into four objectives:
• Objective 1: Selection of pulses varieties and germination experimental design,
• Objective 2 : Influence of the germination parameters on the metabolic pathways
• Objective 3: In situ localization of the enzyme activities during seed germination
• Objective 4: Enzymological characterization and modelling

The outputs will make it possible to gain knowledge on aspects related to metabolic orientation in pulses during germination and on the localization of major enzymes, substrates/products and activities during pulse seed germination. The modelling of the effects of process conditions on germination and seed physiological properties will make it possible to gain knowledge from which legume seed germination protocol optimized for nutritional quality could be proposed. Seed germination video training support will be proposed to local industrialists and small producers in Benin for technology transfer.

Keywords : Pulses, Modelling, Techniques, Proteo/metabolomic, Imaging, Germination process

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GOAL

By an adequate experimental and modelling strategy, and a multi-disciplinary approach mixing metabolomics, imagery, and food process modelling the objective is to identify, localize, and describe the disruption of enzyme activity and biochemistry between the dormancy and the germination state of the pulse. The objective of representation will structure the work and will allow to update knowledge of mechanisms involved and their dynamic. This work will be a first step toward the proposal of a mechanistic model taking into account quantitatively both the synthesis and / or the activation of reaction enzymes, their compartmentalization and the reaction kinetics in situ (in the seed).