Hungarian University of Agricultural and Life Sciences Institute of Food Science and Technology

Institute of Food Science and Technology

Specialization: Product development and Technology Engineering

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Title of thesis: Characterization of Plant Protein Powders: Functional and Digestive Properties

The tendency to use plant proteins is a necessary issue, what distinguishes plant-based proteins is that they are mostly by-products produced as waste from other industries in addition to crops that may have physical damage and cannot be marketed in their natural form and used generally to feed animals. The technological and functional attributes are important aspects in evaluating whether they are suitable for use in food applications.

The study aimed to comprehensively evaluate the techno-functional properties and In vitro digestion simulation to determine protein digestibility and protein quality to evaluate the suitability of plant protein powders as functional food constituents and to identify any differences in their properties and quality that may affect their potential food industry applications. Four commercial plant protein powders, rice protein powder, sunflower protein powder, pea protein powder, and pumpkin protein powder are selected and analyzed by using various analytical techniques. For techno-functional measurements methods were conducted depending on the experiments and samples differed based on the method in two forms (powder and protein solution 5 w/w%). From the powders, color measurement with CR-400 chromameter and water activity with a LabMaster-aw meter, and the dry matter content were done. From the protein solution (5 w/w%), the following measurements were done, pH measurement with pH meter, foaming capacity, foaming stability with whipped methods, oil holding capacity, and emulsion stability were done and calculated based on used references. Rheology test with an MCR 92 Anton Paar Rheometer. Solubility based on dry matter content was measured and solubility based on the comparison between the dry matter content before and after refrigeration for 24 hours was applied also. In the case of In vitro digestion simulation to determine protein digestibility and protein quality, the protein digestibility of the chosen plant protein powders was evaluated after in vitro digestion simulation using the Infogest protocol and amino acid determined with, 10 mg of each protein powder was dissolved in 6 M HCl

(with 1% phenol content) and hydrolyzed using a Milestone Ethos One microwave oven, the quality of the protein were determined based on calculating the DIAAS value of proteins and it was determined by the amount of the most restricting digestible indispensable amino acid (DIAA).

Through the results of the measurements, we conclude that the pH plays an important role in choosing the appropriate product for protein fortification or in the subsequent processes and experiments dependent on it, The color measurement is important for the quality because it will affect the color of the final product, in the case of L* the highest L* values and the lightest are rice protein followed by pea protein powder then sunflower and pumpkin powder respectively, in the case of a* the pumpkin protein powder is the greenish sample, and the most reddish is sunflower protein and rice protein respectively, pea protein powder has the lowest reddish color Pumpkin protein has the highest b* and it has the yellowest color among the samples while pea, sunflower, and rice protein powders have the lowest yellow color respectively. Based on water activity and dry matter content measurement results, we can conclude that protein samples have low moisture and ensure microbial stability for the studied samples. For foaming capacity (FC) and stability (FS) results were for, pea protein, rice protein, and sunflower protein, showing high FC values and good for (FS) as well, in contrast, pumpkin protein shows low values, For oil holding capacity (OHC) and emulsion stability (ES) they show good results show satisfactory and promising results, these parameters have great importance in the food industry. In the case of solubility, it was the most sensitive experiment to the various factors and most of them related to other properties, especially the pH, and its results were good in the case of pumpkin and sunflower protein, and low in the case of pea and rice proteins. For the rheology test results show the dilatant behavior of protein powder samples at a temperature of 20°C was determined between the shear rate 10 to 1000 (1/s). For the in vitro digestibility results show that samples contain all the essential amino acids and based on the DIAAS values, sunflower protein is considered as a high-quality protein powder while, rice protein, pea protein, and pumpkin protein are considered as no quality claim. The results of the studied proteins' techno-functional and digestion ranged between low, good, and excellent. We have noticed that the experiment conditions play an important role in the results. The study was promising and provided satisfactory results in the study of plant-based protein powder, and we can consider it an important base that can be relied upon in the development of food and increase the contribution to sustainability, the use of by-products, and the reduction of waste.