CHAPTER 1

INTRODUCTION

1.1 Project Background

Quinoa also known as *Chenopodium quinoa Willd* is a type of pseudo cereal grain which grows from a plant which is versatile and able to withstand environmental challenges such as drought. The quinoa grain itself is unique compared to other grains due to its protein composition shown from the amino acid composition that are relatively well balanced compared to proteins coming from other grains such as corn and wheat (Filho et.al., 2015). The protein content of this quinoa grain is also considered quite significant at 14% compared to other grains like barley and wheat at 11% and 15% respectively (Filho et.al., 2015).

The conventional method of quinoa protein isolate (QPI) from grains generally includes the use of the quinoa grain turned into a flour, defatted using solvent in order to reduce fat content resulting in increased purity and shelf life in the final product (Galves et. al. 2019), solubilized using an alkaline solution and separation of protein using precipitation with acid solution with protein yields at approximately 6% from the initial weight (Toapanta et al. 2016). The process of the protein extraction in recent studies have seen optimization using the help of enzymatic treatment in order to increase the yield of said extracted protein with the theory that the enzymes during pretreatment are able to break down the cellulose structures bounding the protein bodies, making the protein more available for extraction during solubilization (Rosset et. al.,2012).

Several studies, namely studies by Ansharullah et al. 1997 and Rosset et al. 2012 regarding the use of enzymatic pretreatment in order to extract more protein with increased efficiency have proven that the usage of enzymes does increase protein extraction yield and hence

increasing efficiency. The study by Ansharullah et al. 1997 covered the usage of enzymes, mainly carbohydrases such as viscozyme, in protein extraction from rice bran and found that samples treated with enzymatic pretreatment resulted in higher nitrogen content meaning more protein was extracted at 57% at 50°C compared to 25.75% for conventional at 50°C. The study by Rosset covers the usage of protein extraction from soybean flour using viscozyme L and was found to produce more yield at 56% yield compared to the conventional at only 33% along with findings regarding factors leading to carbohydrate hydrolysis and increased protein extraction in correlation with temperature and enzyme concentration.

Rosset et al. (2012) also tested the omission of alkaline protein solubilization in favour of enzymatic treatment compared to conventional alkaline extraction with the main purpose of verifying the enzymatic effects, interestingly the results from the enzymatic pretreatment resulting in higher protein content at 56% compared to alkaline extraction at 33% as aforementioned before. One of the main reasons and benefits why alkaline solubilization was considered for omission was that using strong alkaline solutions pH 9-11 although may increase protein yield may cause undesired reactions to take place creating toxic compounds such as lysinoalanine. The results from the omission of alkaline protein solubilization is interesting as it may simplify protein extraction along with desirable results such as higher yield, however changes to processing steps in protein extraction can lead to changes in final product functional properties which must be investigated further in this study emphasizing on the changes in functional properties.

Even though it is possible to extract more protein from grain by using enzymatic treatment, this essentially modifies the processing step of the protein extraction and may or may not cause changes in the functional properties of the end products. Functional properties of proteins are important for usage in the food industry as these contribute to how the incorporation of the extracted protein will affect the food processing conditions and end product quality, an example

of the functional properties being water holding capacity, emulsifying properties, gelling properties and solubility (Zayas J. F. 1997). Different functional properties of food ingredients such as extracted protein will result in different applications, example being if a protein isolate has high emulsifying properties it can be used for making sauces, or if a protein has good water holding capacity it can be used as stabilizers in food products etc. (Zayas J. F. 1997). Quinoa protein being mainly gluten free, plant based protein makes it a viable potential ingredient to incorporate in plant base gluten free food. Thus, analyzing the functional properties of extracted quinoa proteins either with or without enzymatic pretreatment is important in order to have an insight into how quinoa protein can be used in the food industry.

Enzymatic treatment may improve extraction results while taking into account the problem of the resultant changes in functional properties, the author will conduct research regarding the use of Viscozyme L enzyme in quinoa protein extraction on the functional properties of the extracted quinoa protein. The functional properties that will be analysed in this study include testing for protein solubility, water holding capacity, emulsifying capacity/stability and foaming capacity/stability. This is done with the objective of determining how quinoa protein may be affected in each category from the control and treatment samples.

1. 2 Research Objectives

The general objectives of this research is:

1. To observe the effect of enzymatic pretreatment of quinoa flour during protein extraction towards the proximate values of protein, fat and ash of quinoa protein sample.
2. To observe the effect of enzymatic pretreatment of quinoa flour during protein extraction on the functional properties of the quinoa protein using Viscozyme L

1.3 Problem Formulation

- What is the effect of enzymatic pretreatment on the proximate values of protein, fat and carbohydrate of the protein samples?
- What is the effect of differences in proximate values in regards to the functional properties of the quinoa protein isolates samples?
- What is the effect of enzymatic pretreatment on the functional properties of quinoa protein isolate samples?

1.4 Research Hypothesis

H_0 = There are no significant differences in proximate values of quinoa protein between conventional protein extraction and protein extraction with enzymatic pretreatment

H_1 = There are significant differences in proximate values of quinoa protein between conventional protein extraction and protein extraction with enzymatic pretreatment.

H_0 = There are no significant differences in functional properties of quinoa protein between conventional protein extraction and protein extraction with enzymatic pretreatment

H_1 = There are significant differences in functional properties of quinoa protein between conventional protein extraction and protein extraction with enzymatic pretreatment.

1.5 Research Scope

- Sample Preparation
    - Conventional or Non-Enzymatic treatment with alkaline protein solubilization (NE-PS)
    - Enzymatic treatment with alkaline protein solubilization (E-PS)
    - Enzymatic treatment with Neutral pH Solubilization (E-NPS)
- Analysis on Quinoa protein functional Properties

- Supporting analysis (Further proximate analysis such as ash and moisture was performed by a colleague)
    - Protein
    - Fat
    - Carbohydrate
- Measuring and analyzing differences between treated and untreated samples
    - Protein solubility
    - Water holding capacity
    - Emulsifying capacity and stability
    - Foaming capacity and stability