

CHAPTER

2

**MICROENCAPSULATION OF
SPIRULINA AS ALTERNATIVE
PROTEIN**

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2.1 INTRODUCTION

Protein is a substance that is very complex and existing in all living organisms. It is one of the important nutrients specifically related within the chemical and biological processes that are crucial for life. The Swedish Chemist, Jöns Jacob Berzelius was the founder who recognised the significance of the proteins in the early 19th century. He invented the name protein in 1838 that originated from the Greek word *prōteios* which means 'primary'. From three out of four parts of the total dry body weight are composed of proteins. Protein is used in body building as the main composition and functional parts of an organism. Plus, it is one specific species since protein is different from one another. It also becomes specific organs, for example the muscle proteins that are dissimilar to brain and liver inside every human body (Haurowitz & Koshland, 2020).

Structurally, proteins mainly consist of carbon, hydrogen, oxygen, and nitrogen as well as minor components of sulfur and phosphorus. Nitrogen is a part of proteins as it can be measured to present the protein

values. The average nitrogen of the standard proteins by weight is 16%. Major proteins are synthesised by amino acid polymers which then bonded together the peptide bonds (Vaidyanathan, 2016).

Furthermore, protein is undeniably important for human dietary. Amino acids are categorised as either essential or non-essential. Essential amino acids cannot be produced by humans and other vertebrates from metabolic intermediates. The human body lacks metabolic pathways required to produce amino acids, hence, it must be obtained from an exogenous diet. Whereas non-essential amino acids are the dispensable amino acids and can be eliminated from a diet (Lopez & Mohiuddin, 2022). Protein daily intake recommendations are determined by total body weight where US Recommended Dietary Allowance (US RDA) is 0.8 g/kg body weight. However, these recommendations do not provide reference category for adults such as by age or sex (Stanzione et al., 2022). Thus, it is a crucial part to ensure that the sources of protein for human dietary intake remains obtainable to prevent diseases due to lack of protein as well as for maintaining cellular function and body composition.

2.1.1 Current Protein Sources

Protein has been trending positively in consumers' perceptions causing a high demand for both plant-based and animal-based sources of protein. While animal proteins have generally considered as the main dietary protein source, there has been a paradigm change in recent years regarding the consumers' dietary intake habits toward plant-based food proteins (Qin et al., 2022). Hertzler et al. (2020) reported that by eating more plant protein may assist to increase intakes of essential amino acids over animal proteins.

De Gavelle et al. (2017) reported in a study that within Europe and USA, dietary protein comes primarily from animal sources for about 55% and 71%, respectively. Based on this proportion, red meat accounts for the majority of animal protein consumption, accounting for 16% to 35%. On the other hand, cereals are the major sources of the intake of

plant protein which is around 40% and 70%. These show different food protein products contribute to different levels of protein.

A previous study by Henschion et al. (2017) about the present protein percent. It stated vegetable protein products comprise the global source of protein at 57%, meat at 18%, dairy at 19%, shellfish and fish at 6%, while other meat products at 9%. Up to date, the current sources of protein that are available in the marketplace for human consumption include cereals as plant-based protein, while meat and dairy from animal-based protein.

Cereal proteins are the main part of worldwide protein consumption and are essential for both humans and animals. In emerging countries, cereal proteins are increasingly essential food intake and wheat records for the widest number of plant sources of protein in the Western diet in the form of bread. Plant proteins can be obtained from corn or maize, rice, oats, and soy depending on staple food consumed in the regions. The content of protein varies from 10% to 15%.

In addition, animal protein is an excellent source of essential amino acids due to its high total consumption and high digestibility. Meat is an essential part of human food intake and beef has served a significant part in the production of energy, protein, and important micronutrients. According to data from the FAO Food Balance Sheet, it is indeed apparent that global consumption of animal products has substantially risen in the last decades. Henschion et al. (2017) also reported that the average intake of meat between 1990 and 2009 raised by about 60%. It is predicted that the number of meats demands will double by 2020. The increased demand needs a rapid increase in supply too given the restrictions on the availability of land and water, as well as the effect of climate change on the production of meat, expanding production efficiencies and modifying the food chain as a whole are crucial.

Dairy-based foods are the leaders in the protein industry, owing to a rapidly integrated global dairy industry and the properties of milk itself, which promotes variability by manufacturing efficient by-product sources. The dairy-based foods have characteristics and nutritional benefits supported by scientific studies that make them an appropriate dietary