Comparative Evaluation of Physico-chemical and Antioxidant Properties of Enzymatic and Acidic Sunflower Protein Hydrolysate

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Abstract

Sunflower meal was a by-product from oil refinery industries. Its defatted meal consisted of high protein content (59.98%) which globulin was found as the major protein constituents. Thus, defatted sunflower meal was excellent protein source to produce protein hydrolysate. In this study, the physical and antioxidant properties of enzymatic bromelain sunflower protein hydrolysate (eb-SPHs) and hydrochloric acid sunflower protein hydrolysate (a-SPHs) were compared. Color of eb-SPHs and a-SPHs was yellowish brown with (hue angles (h°) ranging from 43 to 87), but a-SPHs was darker than eb-SPHs. Results also showed that sodium chloride content and degree of hydrolysis (DH) of eb-SPH were greater than these of eb-SPH. Although a-SPHs and eb-SPHs had high antioxidant activity by 1, 1-diphenyl-2-picrylhydrazyl (DPPH•) and 2, 2'-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) (ABTS⁺•) radical scavenging assays, their activities from eb-SPH were higher than there of a-SPHs.

Keywords: sunflower meal, protein hydrolysates, antioxidant activity, degree of hydrolysis

Introduction

Sunflower is an economic significant oil crop. Sunflower seeds consumed in the baked sunflower seed style, contains high oil content at 48%. After defatting, sunflower meal is a most important source of plant protein. Traditionally, sunflower meal is used for animal feed (Ordonez et al., 2008) which consists of a high relatively protein content and its essential amino acids are phenylalanine, valine, tryptophan, threonine, isoleucine, methionine, cysteine, arginine, lysine and leucine (Salunkhe et al., 1992). Although sunflower protein contains low level of lysine, it is relatively rich of sulphur-containing amino acids of methionine and cysteine (Canibe et al., 1999), glutamic and aspartic acid (Villanueva et al., 1999), compared to other oil seeds. Sunflower seed proteins are valuable alternative food ingredients because they are low antinutritional compounds and toxic substances (Zilic et al., 2010). After ingestion of sunflower protein, gastrointestinal
enzymes may break up proteins, thereby increasing or decreasing their activity of peptides (Barbana et al., 2011). Recently, interest in using sunflower seed meal to produce protein hydrolysate for not only beneficial nutrition but also for value added of its products. The hydrolysate proteins from sunflower seed meal with pepsin and pancreatin could generate ACE inhibitory peptides which amino acid sequence was Phe-Val-Asn-Pro-Gln-Ala-Gly-Ser (Megias et al., 2004). Sunflower protein hydrolysates produced with alcalase plus Flavourzyme® or with pepsin plus pancreatin inhibited in cholesterol incorporation to micelles (Megias et al., 2009). Moreover, Sunflower proteins were hydrolyzed with Flavourzyme® for the production of antioxidant peptide (Ren et al., 2010). Although there are few reports of functional properties, antioxidant of sunflower meal protein hydrolysates with various enzymes, there is no report of sunflower protein hydrolysate and its chemical, functional properties with enzyme ‘bromelain’ which is an endoproteinase extracted from by-product of pineapple industry. Therefore, physico-chemical and antioxidant properties of sunflower protein hydrolysates with bromelain (eb-SPHs) and sunflower protein hydrolysates with hydrochloric acid (a-SPHs) were compared in their study.

Materials and Methods

Defatted sunflower meals were analyzed chemical compositions such as protein, carbohydrate, ash, fiber and oil content by AOAC (2000). Defatted sunflower meals were fractionated by extract with distilled water (albumin), 0.5 M sodium chloride (globulin), 70% ethanol (prolamin) and 0.1 N sodiumhydroxide (glutelin) and then protein content of each fraction was determined with biuret reagent (Chang, 1998). Sunflower proteins were hydrolyzed with 0.5, 1, 6 N HCl at 95°C for 24 h. Sunflower proteins were hydrolyzed with 0, 5, 10, 15, 20, 25% gram of enzyme bromelain per gram of sunflower meal for 1, 6, 12, 18, and 24 h. Hydrolysates were clarified and concentrated by rotary evaporator. Physical and chemical composition of sunflower protein hydrolysates were including degree of hydrolysis (%DH) were determined using trichloroacetic acid (TCA) (Flavia et al., 1998), Sodium chloride content was determined by titration (AOAC, 2000), and antioxidant activities were determined by 1, 1-diphenyl-2-picrylhydrazyl (DPPH•) and 2, 2′-azino-bis (3-ethylbenzthiazoline -6-sulphonic acid) (ABTS+•) radical scavenging assays (Pan et al., 2011; Zielinski et al., 2011).

Results and Discussion

Defatted sunflower meals contained 59.98% protein, 25.29% carbohydrate, 8.75% ash, 5.58% fiber and 0.4% oil on a dry weight basis. It has a high protein content about 60% after defatted according with the result of Bau (1983) who reported protein content of defatted sunflower meal are 53-66%. The relative amounts of the fractionated proteins were calculated as 39.17%, 21.37%, 35.4% and 4.06% for globulin (salt-soluble protein), albumin (water-soluble protein), glutelin (alkaline-soluble protein) and prolamin (alcohol-soluble protein) fraction, respectively. Globulin was the major protein constituents about 39.17%. This result also agrees with Vereijken et al. (2007) and Zilic et al. (2010) who found that globulin is the most constituent of sunflower protein.

The color value showed that all of eb-SPHs and a-SPHs had the same yellowish brown color (hue angles ranged from 43 to 87). The a-SPHs gave darker color than eb-SPHs. NaCl content of a-SPHs ranged from 10.72 to 21.67%, which were higher than % NaCl of eb-SPHs (0.04-0.38%) because of neutralization in acid hydrolysis (Figure 1). % DH of a-SPHs was higher than eb-SPHs. Moreover, % DH of eb-SPHs increased with increasing E/S and time of hydrolysis. The eb-SPHs had higher % scavenging effect on DPPH• and ABTS+• than a-SPHs because enzymatic hydrolysis was more specific cleavage and generated peptides which are more active than acid hydrolysis. Whereas eb-SPHs at 25% E/S for 18 h showed the highest % scavenging
effect on DPPH• and ABTS++ at 90.28 and 89.91, respectively (Figure 2). After 18 h, % scavenging effect on DPPH• and ABTS++ was decreased because size and molecular weight of peptide from eb-SPHs were not suitable to be anti-oxidative peptide. Many reports showed that the antioxidant activity of peptides was highly dependent on their size, sequence and the amino acid composition (Meisel and FitzGerald, 2003). Normally, the anti-oxidative peptides were composed of 5-16 amino acid residues, including hydrophobic amino acids (Chen *et al*., 1996).

**Summary**

The a-SPHs gave the highest %DH, NaCl content and dark color but low antioxidant activities compared to eb-SPHs. It can confirm that sunflower protein hydrolysates generated by bromelain might be suitable for health food more than sunflower protein hydrolysates generated by acid.

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