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Original Research Article

Encapsulation Maltodextrin with Spray Drying Affecting on Shiitake (*Lentinula edodes*) Protein Hydrolysate Properties

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ABSTRACT

Shiitake Mushroom Protein Hydrolysate (ShMPH) is a unique taste and flavor and wide consumption increasing as flavoring agents, foods, and food supplements. The encapsulation technique including the spray-drying process can be used for mushroom hydrolysate powder products by improving their sensory characteristics and functional properties with a long storage time. In this present, *Lentinula edodes* dried powder was hydrolyzed by protease PT (2% by weight of shiitake dried powder) at 50-55°C for 16-20 hours and dried by a spray dryer with the different amounts (10, 15, 20, 25%w/v) of maltodextrin (DE10) carrier at an inlet temperature of 150°C, an outlet temperature of 80°C, and feed rate 10 mL/minute. Amino acid composition, protein content, and sensory characteristics by using an electronic tongue, including the functional properties of ShMPH powder were investigated. The results showed that ShMPH had high water solubility (84.23-85.29%) and foaming capacity (1.45-1.64 mL/g). The amino acid content showed a statistically significant decrease as an increase of maltodextrin addition ($p<0.05$), in the range of 26.75-57.76 mg/g. The most abundant amino acid in ShMPH powder was glutamic acid (6.90-14.80 mg/g). Principle Component Analysis (PCA) of ShMPH powder with the different amounts (0, 10, 15, 20, 25%w/v) of maltodextrin showed an overlap response sensor from all five samples. It showed a similarly tasty profile and a bitterness reduction. In conclusion, fifteen percentages of maltodextrin is the best level for spray-drying Shiitake protein hydrolysate encapsulation. It contained a high amino acid content with good color and no bitterness. The results indicated that the maltodextrin spray-drying encapsulation was helpful to improve their functional properties and can be produced protein hydrolysate powder for several foods and functional foods production.

INTRODUCTION

Shiitake (*Lentinula edodes*), is one of the most popular traditional edible mushrooms, cultivated and widely consumed in many Asian countries such as China, Japan, Korea, Taiwan, and including Thailand. Generally, it is sold in fresh or dried forms. Dried shiitake has high protein (20-23%), carbohydrate (58-60%), and dietary fibre (9-10%) contents, but low in fat (3-4%). It also contains vitamins and minerals (Mau *et al.*, 2021; Chen *et al.*, 2012; Rahman & Choudhury, 2012; Chen *et al.*, 2015; Kwon & Hobbs,

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2005). As protein composition in Shiitake, it contains high amino acids particularly glutamic acid and aspartic acid producing a unique taste and flavor known as "umami" which is preferred by consumers (Dermiki *et al.*, 2013; Yang *et al.*, 2001). In China, Shiitake has long been used as a medicinal mushroom because of its biologically active compounds, particularly lentinan, lenthionine, ergosterol, and ergothioneine (Kwon & Hobbs, 2005; Mau *et al.*, 2021).

Hydrolyzed protein is a mixture composition containing short chain polypeptide and free amino acids, produced by hydrolysis protein from different sources, such as soybean, wheat, algae, fish, gelatin, milk, rice, and grain using microorganisms (autolysis), base or acid solution, or/and enzymes (Olsman, 1979; Peterson, 1981). It was used in various food applications such as soup, gravy, sauce, and snacks (Olsman, 1979). The enzymatic hydrolysis is a mild process, safe, non-expensive, produced by breaking protein or polypeptide chains down into short-chain peptides or free amino acids with protease enzymes under optimized conditions (Olsman, 1979). After the neutralization step, the hydrolyzed mixture was dried. Spray drying is the well-established for conversion of solution into solid particles. This technique is widely used for protein powder production within food, chemical, and pharmaceutical industries, including functional food products. During the spray-drying process, a liquid feed is atomized into tiny droplets in a hot chamber. The hot gas can be changed the conformation of proteins including the type and proportion of covalent or non-covalent interactions (Chen *et al.*, 2012). The carrier agents such as maltodextrin or gum arabic or modified starch can trap the mixture compositions to improve some properties of protein hydrolysate during a drying process (Hong *et al.*, 2021; Chuaychan & Benjakul, 2016; Rao, 2016; Ravichandran, 2014). Maltodextrin, as a wall material, is the most popular carrier agent used for spray-dried encapsulation.

Currently, mushroom protein hydrolysate has become an attractive food ingredient and supplement because of its physicochemical properties, sensory characteristics, and biologically active compounds. It is known that the compositions and properties of protein hydrolysate are influenced by the drying process, especially the wall material used (Kurozawa *et al.*, 2011). This study also aimed to investigate the physical and chemical properties including sensory characteristics changing of enzymatic Shiitake protein hydrolysate powders from spray drying varying the different contents of encapsulation maltodextrin. This research results will be provided for further functional product applications.

MATERIALS AND METHODS

Chemicals and reagents

Hydrochloric acid solution (HCl), sodium chloride solution (NaCl), and monosodium glutamate solution (MSG) were used for calibrating, conditioning, and diagnostic of the electronic tongue and supplied by Alpha M.O.S., Tolouse, France. They were of analytical grade. The protease PT (>1,600 AU/g) in liquid form was ordered from Nutitech Co, Ltd., Thailand. Maltodextrin (DE 10-12, food grade) was purchased from the Krungthepchemi Corporation Co., Ltd., Thailand.

Sample preparation

The fresh shiitake were purchased from a local market in Pathum Thani province, Thailand. It was dried by the method of Pasakawee *et al.* (2018b). It was washed, cut into small pieces, and dried using a hot air dryer at 50±2°C for 18±2 hours until the moisture content had lower than 10±2% (AOAC, 2000) The dried sample was subsequently ground using a blender to achieve the 100-300 mesh of powder. The mushroom powder was packed in aluminum foil bags under reduced pressure and stored at 4-10°C until further hydrolysis.

Shiitake powder was hydrolyzed by 2% (w/w of mushroom powder) protease PT at 55-60°C, pH 6.5-7.0 for 18 hours. After the hydrolysis reaction, the sample was heated at 90±5°C for 15-20 min to terminate the enzyme activity, and then filtered through a 75-mesh nylon bag and centrifuge at 5,500 rpm for 15 minutes. ShMPH in liquid form with a total soluble solid (TSS) of 3±0.2°Brix was then collected and kept at 4°C for overnight.

Encapsulation by spray drying

The maltodextrin encapsulation with spray dryer was modified according to the method of Pasakawee *et al.* (2018a). The ShMPH solution was mixed with different amounts of maltodextrin (10, 15, 20, and 25% w/v) and heated to 80°C for 15 minutes, followed by thoroughly stirring for 30 minutes. The hydrolyzed mixture and wall materials were converted to powder by using a high speed centrifugal spray drier (FnB Machinery & Solutions Inc., Thailand) with an optimal drying condition including inlet and outlet temperatures of 150°C and 80°C, respectively, the pressure of 4 bar, and a feed rate of 10 mL/minute. ShMPH powder was collected and kept in a vacuum aluminium foil bag until further analysis.

Physico-chemical properties analysis

Water activity (a_w) of the sample was measured using a water activity analyser (AquaLab 4TEV, Decagon Devices Inc., USA). The moisture content using the method No.925.10 of AOAC (2000) was done.

The protein content of samples was determined as crude protein by a generic combustion method using a protein/nitrogen determinator (FP-528, LECO, USA). The nitrogen content was measured by thermal conductivity detection and then converted to equivalent protein using the Windows®-based operating software with a default protein factor of 6.25.

The color of the sample powder was measured with a color measurement spectrophotometer (CR-400, Minolta, Japan). The parameter of L* value indicates lightness (0=black, 100=white), a* value indicates chromaticity on a green (-) to red (+) axis, and b* value indicates chromaticity on a blue (-) to yellow axis (+).

Solubility was determined by a modified method of Pavithra *et al.* (2020). A powder (5 g) was vortex-mixed with 10 mL of distilled water and incubated at room temperature for 30 minutes. Then, the mixture was centrifuged at 5,000 rpm for 30 minutes and a height or supernatant was measured. The insoluble residue was collected and dried at 105°C until constant weight. The solubility was computed percentage of soluble weight with sample powder weight (Kang et al., 2014). Water holding capacity was expressed in millilitres per gram of sample powder.

Foaming properties were assessed by a modified procedure of Pavithra *et al.* (2020). A powder (2 g) was mixed with distilled water (100 mL), and homogenized to vigorous shipping for 2 minutes. Then, the mixture was transferred into a cylinder and noted the initial volume in mL. After placing it at room temperature for 5 minutes, the final volume in mL was again noted to calculate the stability of the foam.

Determination of amino acid content

The amino acid content of ShMPH (5 g) was determined by a high-performance liquid chromatography (HPLC) technique with a UV detector. The procedure was managed by the Industrial Metrology and Testing Service Centre, TISTR using the following method No.985.28 of AOAC international.

Electronic tongue analysis

The α-Astree II electronic tongue (Alpha M.O.S., Toulouse, France) was used for Principle Component Analysis (PCA). The electronic tongue consists of 7 field effect-transistor sensor arrays mounted around a central reference electrode (Ag/AgCl). Aqueous solutions of 0.1 mol/L of HCl, NaCl, and MSG were used for calibrating, conditioning, and diagnostic of the e-tongue. A sensor set comprises 7 sensors (ANS, PKS, CTS, NMS, CPS, ANS, and SCS) that were developed for food applications. The specialty sensor of ANS, CTS, and NMS refers to sourness, saltiness, and umami, respectively. The ShMHP powders (2 g) were rehydrated in 100 mL of DI water. All samples were controlled with a total soluble solid at 2±0.2°Brix before analysis. The analytical measurement of each sample was conducted by immersion of the sensor array in an aliquot for 120 seconds. The average intensity reading (mV) of the last 20 seconds of analysis was used for statistical calculation. Each sample was analyzed 15 times, with the first 3 analyses disregarded (as per manufacturer's instructions) due to varied or unstable mV readings. Thus, the twelve measurements were calculated.

Statistical analysis

All of the samples were carried out in triplicate, except for the electronic sensory test (n=12). The data analyses were performed using the Microsoft EXCEL and reported as mean± standard deviation. Principal component analysis (PCA) was carried out to summarize the effects of encapsulation maltodextrin content on the response patterns of taste sensors, using the Alpha M.O.S. statistical software. Analysis of variance (ANOVA) was done to determine the significance of the means and using Duncan's test with confidence level at 95% ($p<0.05$).

RESULTS AND DISCUSSION

Physico-chemical properties of Shiitake protein hydrolysate powder

The purpose of the present study was to evaluate some properties of ShPMH spray-dried powder with different amounts (10%, 15%, 20%, and 25%) of encapsulated maltodextrin. The moisture content is very important quality of powder products. In general, the powder product had a low water activity (<0.6) and moisture content (<10%) affects microorganism safety resulting in prolong stability and shelf life of the powder sample (Labuza, 1984). In this study, the moisture content and water activity of all four samples ranged from 6.54%-7.16% and 0.2824-0.3344, respectively (Table 1.). There was a slightly reduction when the content of maltodextrin increased ($p<0.05$). From the previous study, the water activity of powder products should be below 0.3. Maqsoudlou *et al.* (2020) reported that water activity of spray-dried powder from bee pollen protein hydrolysate using maltodextrin was 0.255-0.265. And Wang *et al.* (2020) reported the water activity of spray-dried soybean hydrolysate powders in the range of 0.27-0.28. The lowest and highest water activity were found in ShMPH powder with 25%maltodextrin encapsulation and ShMPH powder with 10%maltodextrin encapsulation, respectively. As a result, the water activity of ShMPH powder was found to decrease with increasing maltodextrin contents. The increasing of solid content in hydrolysate solution could lead to a reduction of free water content. Thus, high encapsulation of maltodextrin in hydrolysate powder could reduce its water activity. Therefore, it is necessary to select a high-quality packaging for storage powder such as an aluminium foil bag. However, all four ShMPH powders were prepared under similar drying condition so it might be a slightly difference between the moisture content and water activity of sample.

The yield of ShMPH powders increased from 8.95% to 17.03% as same as the maltodextrin encapsulation increased from 10% to 25%. In the contrast, the protein content of ShMPH sample powders was reduced significantly from 7.27% to 2.98% when the concentration of maltodextrin increased from 10% to 25% ($p<0.05$). This finding agrees with the report of Hong *et al.* (2021) who studied the spray drying condition for crocodile meat protein hydrolysate. In general, maltodextrin is a high molecular compound that is less hygroscopic. During spray drying, maltodextrin compounds bound to dry matter compound in protein hydrolysate, thus a high maltodextrin content in hydrolysate powder could decrease its protein content and moisture contents but increase a dry matter yield.

According to the theory of the CIELAB, the L* value is an indicator of lightness (at high) or darkness (at low). It increased from 81.50 to 84.46. The a* value represents redness when positive and it is an indicator of greenness when negative. It reduced from 2.77 to 2.07. The b* value is an indicator of yellowness when positive and blueness when negative. It decreased from 18.46 to 15.27. It indicated that the color of ShMPH powders showed a light brown-yellow color (as shown in Figure 1.). Higher L* value was found when maltodextrin increased. In contrast, lower a* and b* values were found when maltodextrin increased. Generally, the color of protein hydrolysate powder was generated by the nonenzymatic browning reaction or Maillard reaction of aldehydes, or ketones, or an amine group of free amino acids/peptides in hydrolysate solution and a carbonyl group of reducing sugar in maltodextrin during the spray-drying heat process (Chuaychan & Benjakul, 2016; Ching *et al.*, 2011). Therefore, it is associated with the different amounts of maltodextrin used.

The solubility and foaming properties are the most important functional properties of powder products. There was no significant difference in solubility of all sample powders analyzed as shown in Table 1. ShMPH treatment of 10% maltodextrin encapsulation had the lowest water holding capacity (0.19 mL/g), foaming capacity

(1.45 mL/g), including foaming stability (96.68±0.57%). The increase in water holding capacity, foaming capacity, including foaming stability were found when the maltodextrin increased from 10% to 15%. It was slightly different for other concentration samples. There was no significant difference in water holding capacity, foaming capacity, and foaming stability for ShMPH powders encapsulated with 15%, 20%, and 25% maltodextrin ($p \geq 0.05$). These showed in the range of 0.26-0.28 mL/g and 1.47-1.48 mL/g, and 98.40-98.75%, respectively. Generally, maltodextrin is hydrophilic in nature due to polysaccharide composition, thus the water solubility of powder is improved (Chuaychan & Benjakul, 2016; Ravichandran *et al.*, 2014).

Amino acid content of Shiitake protein hydrolysate powder

Table 2 shows the amino acid composition of ShMPH powder with 10%, 15%, 20%, and 25% of maltodextrin encapsulation. The amino acid content of ShMPH powders significantly decreased with an increase of maltodextrin addition ($p<0.05$), in the range of 26.75-57.76 mg/g. The ShMPH powder with 25%maltodextrin encapsulation which contained the highest maltodextrin had the lowest amino acid content of 26.75±0.16 mg/g sample, while the ShMPH powder with 10% maltodextrin encapsulation treatment had the highest amino acid composition of 57.56±0.31 mg/g sample.

They were similar to the amino acid profile of all ShMPH powders. The most abundant amino acid in ShMPH powder was glutamic acid (6.90-14.85 mg/g sample) and aspartic acid (2.42-5.31 mg/g sample) producing an umami taste and flavor. This finding agrees with the report of Dermiki *et al.* (2013) who reported that Shiitake is rich in compositions of aspartic acid, glutamic acid, 5'-guanosine monophosphate (5'-GMP), 5'-inosine monophosphate (5'-IMP), 5'-xanthosine monophosphate (5'-XMP), and 5'-adenosine monophosphate (5'- AMP). Some amino acids may be reduced during the blanching and hydrolysis steps.

As the report of Yang *et al.* (2001), the amino acids are grouped based on their taste characteristics, umami or MSG-like (aspartic acid and glutamic acid), sweetness (alanine, glutamine, glycine, proline, serine, and threonine), bitterness (arginine, histidine, isoleucine, leucine, methionine, phenylalanine, tryptophan, and valine) and tasteless (lysine and tyrosine). In this study, the results showed that the ratio of essential amino acids (EAA) and total amino acids (TAA) of all powder samples had approximately 0.36-0.38. The umami amino acids had about 35% of total amino acids in all four ShMPH powder samples. The sweetness amino acids (UA) and bitterness amino acids (SA) were 24-27% of TAA in all samples. Moreover, it also showed that all four ShMPH samples had a ratio of SA and UA of approximately 1:1. The bitter amino acids had a high proportion in the ShMPH powder sample, but can be masked by the sweet amino acids, as the report by Mau *et al.* (2021).

10%MD 15%MD 20%MD 25%MD

Figure 1. ShMPH powder with the different amounts of maltodextrin (MD).

Table 1. Physico-chemical properties of ShMPH powder with the different amounts of maltodextrin (MD).

Physico-chemical properties	10% MD	15% MD	20% MD	25% MD
Yield (%)	8.95	11.01	10.15	17.03
Moisture content (%)	7.15±0.08^{a}	6.88±0.03^{b}	6.73±0.03^{b}	6.54±0.14^{c}
Water activity	0.3344±0.0014^{a}	0.2870±0.0028^{b}	0.2949±0.0026^{b}	0.2824±0.0052^{b}
Protein content (%dry weight)	7.27±0.09^{a}	5.51±0.04^{b}	4.26±0.11^{c}	2.98±0.08^{d}
Color: L* value	81.50±0.09^{d}	83.08±0.02^{b}	82.79±0.12^{c}	84.46±0.01^{a}
a* value	2.77±0.03^{a}	2.33±0.05^{c}	2.38±0.02^{b}	2.07±0.02^{d}
b* value	18.46±0.07^{a}	17.40±0.08^{b}	17.40±0.04^{b}	15.25±0.03^{c}
Solubility (%)^{ns}	84.57±0.58	84.22±0.84	84.72±0.24	85.29±0.40
Water holding capacity (mL/g)	0.19±0.07^{b}	0.26±0.08^{a}	0.28±0.05^{a}	0.28±0.04^{a}
Foaming capacity (mL/g)	1.45±0.01^{b}	1.48±0.01^{a}	1.48±0.01^{a}	1.48±0.01^{a}
Foaming stability (%)	96.68±0.57^{b}	98.49±0.59^{a}	98.75±0.69^{a}	98.40±0.73^{a}

Note: $^{a-c}$Different letters in the same row indicate significant difference ($p<0.05$).

^{ns}Means in the same row are not significantly different ($p \geq 0.05$).

Table 2. Amino acid compositions of ShMPH powder with the different amounts of maltodextrin (MD).

Amino acid compositions (mg/g sample)	10% MD	15% MD	20% MD	25% MD
Aspartic acid, Asp[(1)]	5.31±0.02[a]	4.06±0.01[b]	3.15±0.05[c]	2.42±0.02[d]
Glutamic acid, Glu[(1)]	14.85±0.01[a]	11.57±0.02[b]	9.22±0.25[b]	6.90±0.01[c]
Threonine, Thr[(2),*]	3.12±0.01[a]	2.38±0.01[b]	1.89±0.05[c]	1.43±0.00[d]
Serine, Ser[(2)]	2.92±0.01[a]	2.22±0.02[b]	1.76±0.05[c]	1.32±0.00[d]
Proline, Pro[(2)]	2.26±0.00[a]	1.74±0.01[b]	1.37±0.03[c]	1.01±0.00[d]
Glycine, Gly[(2)]	2.67±0.03[a]	2.06±0.02[b]	1.56±0.06[c]	1.27±0.01[d]
Alanine, Ala[(2)]	3.65±0.01[a]	2.83±0.00[b]	2.23±0.02[c]	1.75±0.00[d]
Valine, Val[(3),*]	2.95±0.02[a]	2.28±0.01[b]	1.83±0.06[c]	1.36±0.00[d]
Methionine, Met[(3),*]	0.36±0.02[a]	0.30±0.02[b]	0.27±0.03[b]	0.17±0.01[c]
Leucine, Leu[(3),*]	3.41±0.00[a]	2.65±0.02[b]	2.17±0.09[c]	1.52±0.01[d]
Isoleucine, Iso[(3),*]	2.27±0.02[a]	1.77±0.02[b]	1.44±0.06[c]	1.04±0.00[d]
Phenylalanine, Phe[(3),*]	4.46±0.00[a]	3.82±0.02[b]	3.30±0.20[c]	2.01±0.01[d]
Tryptophan, Try[(3),*]	0.45±0.01[a]	0.35±0.00[b]	0.25±0.00[c]	0.27±0.00[c]
Histidine, His[(3),*]	0.83±0.00	0.65±0.01	0.52±0.02	0.46±0.00
Cystine, Cys[ns]	0.49±0.05	0.41±0.09	0.31±0.01	0.34±0.06
Tyrosine, Tyr	1.97±0.04[a]	1.62±0.10[b]	1.34±0.10[c]	0.97±0.01[d]
Lysine, Lys[*]	3.12±0.01[a]	2.39±0.01[b]	1.90±0.06[c]	1.41±0.00[d]
Arginine, Arg	2.66±0.03[a]	2.06±0.05[b]	1.65±0.07[c]	1.12±0.01[d]
TAA scores	57.56±0.31[a]	45.16±0.44[b]	36.15±1.21[c]	26.75±0.16[d]
EAA:TAA ratio	0.36	0.37	0.38	0.36
UA	20.16	15.63	12.36	9.32
SA	14.63	11.23	8.81	6.78
BA	14.76	11.83	9.78	6.81

Note: *EAA: essential amino acid, TAA: total amino acid,

[(1)]umami amino acid (UA), [(2)]sweetness amino acid (SA), [(3)]bitterness amino acid (BA)

[a-c]Different letters in the same row indicate significant difference ($p<0.05$).

[ns]Means in the same row are not significantly different ($p\geq0.05$).

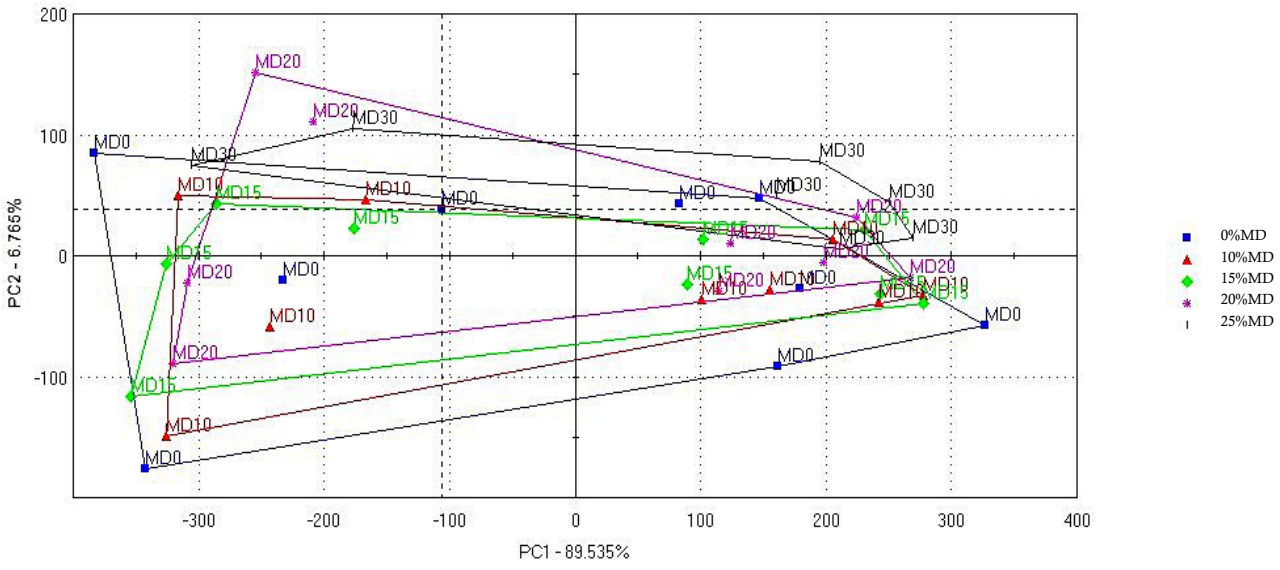

Figure 2. Principal Component Analysis (PCA) of ShMPH powder with the different amounts of maltodextrin (MD).

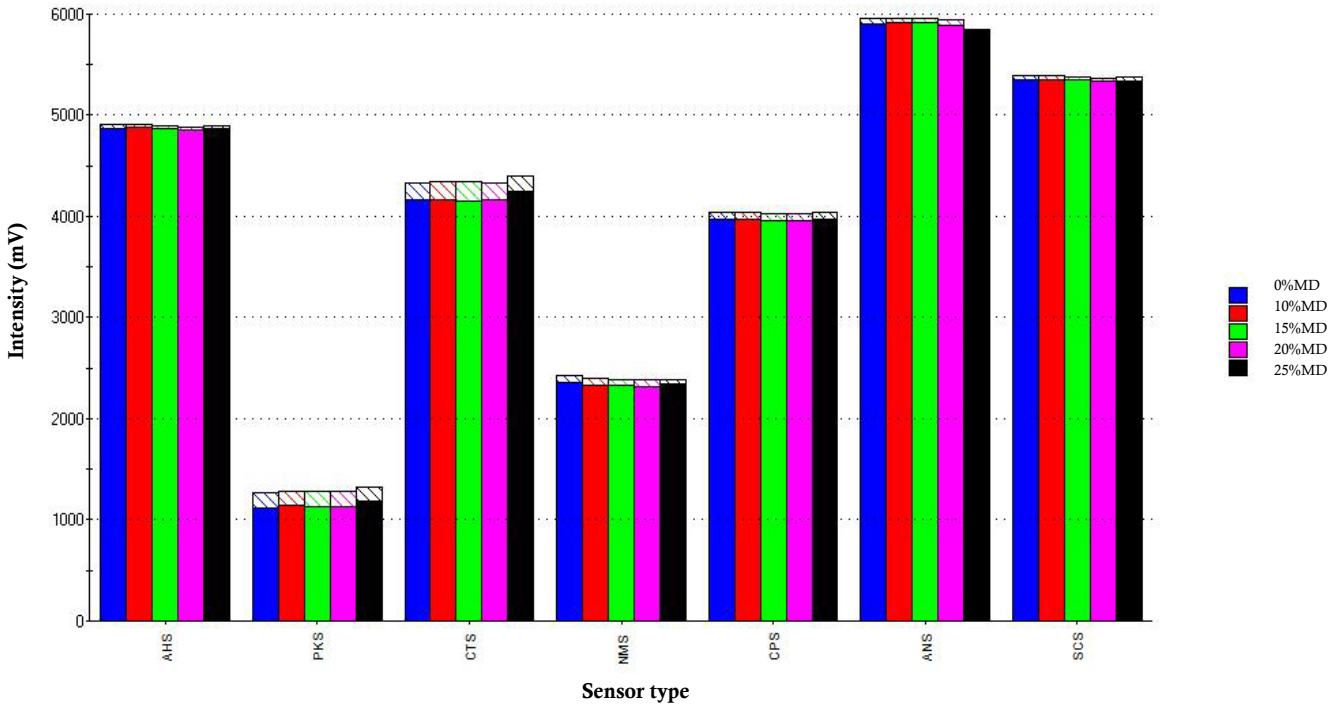

Figure 3. Intensity (mV) of each sensor response on ShMPH powder with the different amounts of maltodextrin (MD).

Principal component analysis (PCA) of Shiitake protein hydrolysate powder

Principal component analysis (PCA) was applied in order to evaluate the data of taste measurement using the electronic tongue (Figure 2.). Principal component analysis is a technique for reducing the number of variables by finding a linear combination of variables that explains the variance in the original variables. The sensor technology as an electronic tongue has been applied to identify and classify different taste of food samples. Each chemical sensor has different organic membrane coating. Generally, Due to the coating type, each sensor is cross-selective and cross-sensitive to different taste attributes, like human taste buds. It was mapped using the relative voltage response of the electronic tongues sensors to the samples (Figure 1.). It was distributed on the two-dimensional plane of the first (PC1) and second (PC2) principal components. The result shows that all samples are not discriminated (discrimination index of -362%). It accounted for 96.31% of variance (PC1 89.54%, PC2 6.77%). Regarding the distribution of the evaluated 7 taste sensors, the component was not correlated with taste profile. In term of individual sensor, sensor of AHS, PKS, CTS, NMS, CPS, ANS, and SCS showed discrimination power of 0.041, 0.023, 0.035, 0.040, 0.023, 0.265, and 0.036, respectively. The PCA graph wasn't separated the different tastes of all four samples. The position of samples groups of the PCA plot show similarity of that of the sensory evaluation. It indicates that the taste profiles of ShMPH with different maltodextrin amounts in the range of 10-25% were similar.

Figure 3. shows the intensity (mV) of 7 sensor responses on ShMPH powder containing different amounts of maltodextrin encapsulation. There was no significant difference in the intensity of each sensor in all ShMPH powders and ShMPH liquid samples ($p \geq 0.05$), AHS 4,861.81-4,878.61 mV, PKS 1,117.69-1,188.59 mV, CTS 4,158.47-4,249.19 mV, NMS 2,323.81-2,341.62 mV, CPS 3,954.44-3,978.68 mV, ANS 5,843.59-5,918.71 mV, and SCS 5,339.93-5,358.54 mV (no raw data shown in this paper). The RSD varied between 0.58% and 13.12%. This result indicates that all four ShMPH powders had a similar taste profile in comparison with a control (ShMPH liquid sample, no maltodextrin added). Figure 3. shows that ANS sensor which respect to sourness had the highest intensity (5,843.59-5,918.71 mV). In general, aldehydes or ketones or amine groups of free amino acids or peptides in hydrolysate solution and reducing sugar in maltodextrin were reacted to flavor and taste development during the drying step. The high hydrolyzed protein concentration in the mixture probably also improves strong flavor and taste. In this experiment, the addition of maltodextrin also reduces the content of amino acids. However, all four ShMPH powders using similar drying condition, didn't affect the overall taste profile of ShMPH powder. There is related to the amino acid profile of all four ShMPH powders, as shown in Table 2.

CONCLUSIONS

The properties in terms of physico-chemical properties and sensory characteristics of Shiitake protein hydrolysate spray-dried powder with different amounts of maltodextrin. Maltodextrin encapsulation can be used as a carrier agent for Shiitake hydrolysate production. The increased amount of maltodextrin affected a reduction of protein content and amino acid contents on Shiitake hydrolyzed powder products. It was able to increase the yield and improve the color, solubility, and foaming properties of hydrolysate powder products. There was no effect on taste profile changing of Shiitake protein hydrolysate. The low moisture content and water activity were guarantee the stability of hydrolysate powder. In the present study, 15% of encapsulation maltodextrin is the best level for Shiitake protein hydrolysate spray drying. It contained a high amino acid content (45.16±0.44 mg/g sample) with good color (light brown-yellow) and less bitter amino acids.

Therefore, the maltodextrin encapsulation with spray drying has potential benefit for the development of functional products.

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