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FULL PAPER

Effect of milkfish skin gelatin on properties of vegetable wet noodle

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Abstract

Vegetable wet noodles are one of the healthy noodles which have been part of a functional noodle. Wet noodles are a type of noodle with a chewy texture that are usually served immediately after production. However, the low tensile strength makes the noodles easily break, therefore it is necessary to mix it with gelatin to get noodles with good quality. Fish skin gelatin could improve physico-chemical, nutritional and functional quality of vegetable wet noodles. Consequently, the purpose of this study is to examine the effect of milkfish skin gelatin on the properties of vegetable wet noodle. Various concentration of milkfish skin gelatin (0.5%, 1%, 1.5%, 2% and 2.5%) were added to vegetable wet noodle dough. Physico-chemical properties of vegetable wet noodle were analyzed including tensile strength, Scanning electron microscope, proximate, color, total pigment, amino acid content and antioxidant activity. The addition of 2.5% of fish skin gelatin exhibited the highest tensile strength or breaking strength (0.18 MPa). SEM test results showed a dense matrix structure, uniform and compact cavities. Value of water content was 59.49%, protein content was 8.92%, ash content was 0.4%, fat content was 1.06%, carbohydrate content was 30.13%. Whereas, total pigment with chlorophyll value a was 3 mg/g, chlorophyll b was 2.46 mg/g and carotenoids was 1.32 mg/g. The color test obtained the results of the parameters L* 70.51, a* -5.37, and b* 11.56, respectively. There were major essential amino acids such as leucine, phenylalanine, and arginine. Furthermore, hedonic analysis showed that the consumer prefers to choose wet vegetable noodle after 2.5% gelatin addition due to bright green appearance, the specific aroma and the chewy texture of noodle.

1. Introduction

Milkfish (*Chanos chanos*) inhabits the Indo-Pacific tropical region and has a significant domestic demand. According to FAO (2018) data, Indonesia ranks second in the world. Every year, the increasing production of fisheries goods is followed by a rise in the quantity of fish consumed. The greater the consumption of fish, the greater the amount of trash generated, including solid waste in the form of skins, bones, skin, and swimming bladder from fish processing activity (Nurilmala *et al.,* 2022). To date, fish skin can be utilized as for food ingredients including gelatin. Gelatin is a naturally occurring soluble protein that functions as a gelling or non-gelling agent. Fish gelatin is deemed widely applicable because it does not violate religious prohibitions and possesses the same level of safety and physicochemical properties as gelatin in general (Sha *et al*., 2022).

Due to the high carbohydrate content of noodles, several Asian countries, including Indonesia, substitute noodles for rice. Wet noodles have several disadvantages, including a low nutritious content and a short shelf life. Noodles have a 10- to 12-hr shelf life at room temperature due to their 52% water content. In addition to having a poor protein and vitamin content, wet noodles contain only 4% of the daily value for each (Candra and Rahmawati, 2018). Based on the aforementioned considerations, it is important to improve the characteristics of wet noodles by addition of

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fish gelatin and vegetable extract. Milkfish skin gelatin can be used to increase the elasticity so that they have a chewy property. Furthermore, vegetable extracts can be added to noodles to boost their nutritional and functional properties. The aim of this study was to improve the physicochemical and nutritional properties of vegetable wet noodles by incorporating milkfish skin gelatin (MSG).

2. Materials and methods

2.1 Milkfish skin gelatin preparation

MSG was extracted using the papain enzyme based on previous studies by Haryati *et al*. (2019) and Norziah *et al*. (2014). Milkfish skin and other contaminants were removed from the meat. To remove non-collagen proteins, the clean milkfish skin was extracted for 12 hrs using a solution (1:3) containing 0.03% papain enzyme. After 12 hrs of extraction, the skin was neutralized with distilled water. The extract was then immersed in distilled water (1:3) for 24 hrs at 60°C. Then, the extract was dried at 60°C for 48 hrs.

2.2 Vegetable wet noodle preparation

Based on the method described by Nasution *et al.* (2006), vegetable wet noodle was created by mixing all ingredients based on treatment (Table 1). The dough was then shaped with a noodle grinder into 15 cm long noodles that were 1-2 mm thick. After that, the noodles were cooked for 5 mins.

2.3 Cooking properties

The cooking qualities were carried out in accordance with Tao *et al.* (2019) with slightly modifications. Vegetable wet noodle (10 g, W1) was added to boiling water (400 mL) for 15 mins, washed roughly five times with chilled deionized water, and weighed (W2) after filter paper was used to remove surface moisture. The cooking and washing water were then collected and dried at 105°C to a consistent weight (W3). The calculation for cooking loss (W%) and water absorption (M%) was as follows:

$$W\% = \frac{W3}{W1} \times 100\% \quad (1)$$

$$M\% = \frac{W2 - W1}{W1} \times 100\% \quad (2)$$

2.4 Tensile strength

The tensile strength of untreated and treated of vegetable noodle were carried by using texture analyzer TATX Plus.

2.5 Scanning electron microscopy

Scanning Electron Microscopy (SEM) was performed to know the effect of milkfish skin gelatin on the structure of vegetable wet noodles. The microstructure of noodle was analyzed by using JEOL JCM 7000.

2.6 Proximate analysis

The proximate analysis was conducted according to Indonesian National Standard (1992). The untreated and treated vegetable wet noodle were analyzed for moisture content, protein, lipid and ash. Whereas carbohydrate was calculated by difference.

2.7 Color degree

The color degree test was conducted according to Billina *et al.* (2014) by using Colorimeter Konica Minolta CR-400. Wet noodles were boiled for 10 mins. The cooked wet noodles were determined the coordinates of X, Y, whereas X length and Y first length. The measurements were conducted in triplicates.

2.8 Total pigment

The total pigment analysis was performed with modifications according to Hajimahmoodi *et al.* (2010) and Branisa *et al.* (2021). Using a spectrophotometer, chlorophylls and carotenoids were analyzed as pigments (pigments) (UV-Vis mini 140, Shimadzu Japan). Sample methanolic extracts were analyzed for chlorophyll a and b as well as carotenoids at a specified wavelength.

2.9 Amino acids

Amino acids in microalgae powder were determined using LC-MS/MS for methionine and cystine analysis, while L-tryptophane was detected using HPLC. The other amino acids were analyzed using an UPLC system equipped with a C18 column; the samples were eluted in eluent Accq, Tag Ultra, and distilled water, with column temperature: 49°C and equipped with PDA detector.

Table 1. Formulation of vegetable wet noodles with addition of milkfish skin gelatin.

Ingredients	Treatment					
	0%	0.5%	1%	1.5%	2%	2.5%
Milkfish skin Gelatin (g)	0	0.8	1.5	2.3	3	3.8
Terigu flour (g)	150	149.2	148.5	147.7	147	146.2
Egg (g)	56	56	56	56	56	56
Bok choy (g)	16	16	16	16	16	16
Total	222	222	222	222	222	222

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Meanwhile, The L-tryptophan analysis was determined according to AOAC 988.15 by using HPLC equipped with column RP-18 and eluted in 8.5 mM NaOAc (A) and MeOH (B) with an isocratic system. The injection volume was 15 µL at ambient temperature and detected in PDA detector at 280 nm.

In addition, the L-cysteine and methionine were evaluated according to Commission Regulation (EC) No. 152/2009 and Lassen 2018 with modification. They were evaluated LC-MS/MS equipped with Imtakt Intrada Amino Acids. The 2 µL samples in 50% of MeCN were injected and eluted at a flow rate of 0.4 $mL.min^{-1}$ in 0.1% CH_2O_2 in MeCN (A) and 100 mM formic ammoniac (B). The analysis was conducted in a gradient system with column and autosampler temperatures were 37°C and 8°C, respectively. The method of MS/MS analysis with the interface of ESI (-) and the MRM parameter for L-methionine was a precursor (m/z) 179.95 and product (m/z) 78.90, while for L-methionine was precursor (m/z) 167.95 and product (m/z) 151.00.

HPLC System S433 (Sykam, Germany) was used for other amino acids. About 100 mg of freeze-dried biomass was resuspended in 5 mL 1 N HCl with 1% (w/v) phenol and washed for 1 min with N_2 gas. The sample solutions were dried for 24 h at 110°C and then filtered. The probes were evaporated, diluted in a sample solution buffer, and injected onto column (4.6 150 mm, LCA K06/Na; Sykam, Germany), detected at 440 and 570 nm. The analysis was carried out in 60 mins with the following parameters: flow rates of 0.45 $mL.min^{-1}$ for buffer and 0.25 $mL.min^{-1}$ for ninhydrin. With formulas No. 1 and 2, the total amounts of alanine, asparagine, aspartic acid, arginine, cysteine, glutamic acid, glutamine, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, and valine were determined. The content of asparagine and aspartic acid and the content of glutamine and glutamic acid are presented as the sum of both amino acids, based on acidic hydrolysis.

With A spl = analytical area of amino acids; AIS = area of internal standard; Cstd = Concentration of amino acids standard ($pmol.\mu L^{-1}$); BM = amino acids molecular weight; Va = final sample volume (µL); Fp = dilution factor; Wspl = weight of samples (g); V spl = volume of sample (mL); a = intercept; b = slope; V = sample volume (mL); Fp = dilution factor; W spl = sample weight (g); V spl = sample volume (mL); BM cystine : 120.15 $g.mol^{-1}$; BM cysteic acid = 169.16 $g.mol^{-1}$; BM cystine : 149.21 $g.mol^{-1}$; BM cysteic acid = 181.21 $g.mol^{-1}$.

$$\text{Aspl} = \frac{A\ spl}{AIS} \tag{3}$$

$$\text{Amino acids (mg/L, mg/kg)} = \frac{\frac{Sample\ ratio}{standard\ ratio} \times \frac{Cstd}{1000000} \times BM \times Va \times Fp}{W\ spl\ or\ V\ spl} \tag{4}$$

$$\text{Methionine (mg/L, mg/kg)} = \frac{\left(\frac{Area - a}{b}\right) \times V \times Fp}{W\ spl\ or\ V\ spl} \tag{5}$$

$$\text{Cystine (mg/L, mg/kg)} = \frac{BM\ cystine}{BM\ cysteic\ acid} \times cysteic\ acid\ content \tag{6}$$

2.10 Antioxidant activity

The complementary study for the antioxidant capacity of the extract was confirmed by the DPPH (1,1-diphenyl-2-picrylhydrazyl) scavenging assay according to Abd Rashid *et al*. (2022) with slight modification. 2 mg of extract were dissolved in 2 mL of ethanol, and the DPPH radical scavenging activity was measured in triplicate. BHT served as the control. 2 mL of ethanolic DPPH was added to samples as well as control and vigorously vortexed. The test tubes were permitted 30 mins at room temperature and in the dark. Using a UV/Vis Spectrophotometer with an absorbance measurement of 517 nm, the reduction of DPPH radicals in a cookie sample was measured (Shimadzu, Japan). Using the following formula, radical scavenging activity is reported as a percentage of DPPH free radical inhibition.

$$\%\ \text{inhibition} = \frac{AbsControl - AbsSample}{Abs\ Control} \times 100\% \tag{8}$$

2.11 Hedonic analysis

The hedonic analysis was conducted in accordance with the 2015 Indonesian National Standard No. 2346. The appearance, odor, flavor, and texture of untreated and treated vegetable wet noodles were evaluated. The hedonic analysis was carried out by thirty untrained panelists from Department of Fish Products Technology, Universitas Diponegoro.

3. Results and discussion

3.1 Cooking properties

The cooking qualities of a sample are an essential indicator of its cooking quality. The range of cooking loss for untreated and treated samples was between 3.67 and 8.83%, whereas the range for water absorption was between 23.82 and 30.03%. The addition of 2.5% milkfish skin gelatin to wet vegetable noodles decreased cooking loss (3.67%) and increased water absorption (30.03%) (Table 2). The fortification of milkfish skin gelatin reduced cooking loss and enhanced water absorption. The decrease in cooking loss and the rise in water absorption quality indicate improved product quality (Zhang *et al*., 2022). This result was supported by Rumansi *et al*. (2021). Gelatin is capable in forming and stabilizing emulsions, increasing water-holding capacity, and decreasing cooking shrinkage values. The cooking loss properties are affected by the protein content of

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Table 2. Cooking properties of vegetable wet noodle after addition of different concentration of milkfish skin gelatin.

	Treatment					
	0 %	0.5%	1%	1.5%	2%	2.5%
(W%)	8.83±1.04[c]	7.83±1.04[bc]	7.33±1.53[bc]	6.00± 1[abc]	5.00±1.32[ab]	3.67±1.15[a]
(M%)	23.82±1.54[a]	25.06±1.28[ab]	27.00±0.42[bc]	28.05±1.15[bc]	29.00±1.32[c]	30.03±0.78[c]

Values are presented as mean±SD. Values with different superscripts within the same column are statistically significantly different ($p<0.05$).

product, the lower cooking loss resulting in higher protein concentration. Due to the ability of gelatin to bind water, the amount of free water in the product is decreased (Murdiati *et al*., 2015).

3.2 Tensile strength

The addition of milkfish skin gelatin altered the tensile strength of wet vegetable noodles (Figure 1). The addition of higher concentration of MSG to wet vegetable noodles increased its tensile strength. Wet vegetable noodle treated with 2.5% milkfish gelatin demonstrated the highest tensile strength compared to other treatments, however untreated noodles (0%) exhibited the lowest tensile strength. This result is supported by Susanty and Pujilestari (2014), who utilized gelatin to enhance the properties of jelly sweets. Gelatin could enhance jelly candy's gel formation and its tensile strength.

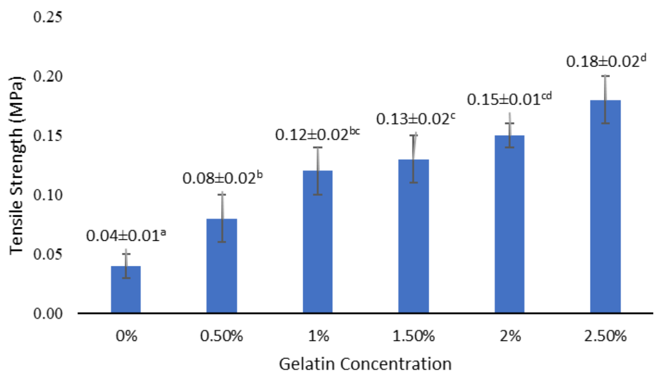

Figure 1. Tensile strength of vegetable wet noodle after addition of milkfish skin gelatin at different concentrations. Values are presented as mean±SD. Values with different superscripts are statistically significantly different ($p<0.05$).

3.3 Scanning electron microscopy

SEM can assist in analyzing the micromolecule structure of products. Wheat dough is a continuous matrix of starch granules embedded in a network of gluten. The addition of MSG could alter the formation of the gluten network and alter the characteristics of vegetable wet noodles. Figure 2 presents the microstructure of untreated and treated vegetable wet noodle with MSG.

The microstructure of treated vegetable wet noodles with MSG was more compact and denser than untreated. At concentrations of 2% and 2.5% MSG, the microstructure appears more solid and compact than at other concentrations. Increased concentration of MSG would improve the ability of vegetable wet noodle materials to bind water to form a porous structure, resulting denser product. The addition of hydrocolloids, like gelatin, can improve the microstructure of products with reduced estrangement, resulting denser and more compact structure.

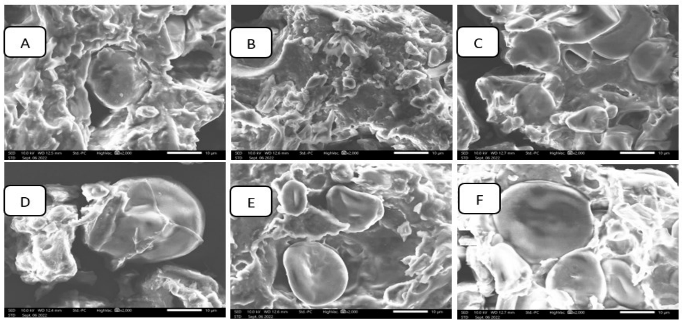

Figure 2. Microstructure of wet vegetable noodle after addition of milkfish skin gelatin (A: 0%; B: 0.5%; C: 1%, D: 1.5%, E: 2%, F: 2.5%) at magnification 2000×.

3.4 Proximate of wet vegetable noodle

The proximate composition of wet vegetable noodle without and with MSG reveals high levels of mineral, protein, water and low level of fat (Table 3). The protein content of vegetable wet noodle ranges from 8.29 to 8.92%. In general, protein content made from flour had a lower protein content, but the addition of gelatin increased the protein level of wet vegetable noodle. This is owing to the use of milkfish skin gelatin, which is a protein source (Nurilmala *et al*., 2017). The protein content of these results was higher than that of gluten-free functional noodles after enrichment with fish gelatin hydrolysate (Wangtueai *et al*., 2020).

The fat content of wet vegetable noodle ranged from 1.06 to 1.82%. In comparison to noodle prepared from root and tuber composite flour, the fat level of this study was low (Akonor *et al*., 2017). After enriching with varied concentrations of MSG, the fat content of wet vegetable noodle was reduced. Gelatin contains a lot of amino acids, especially proline and hydroxyproline. They aggressively bind water, therefore the binding between water and fat was reduced (Halim *et al*., 2014).

Total ash denotes the mineral content of a food product. The ash content ranged from 0.24 to 0.4%, with 2.5% accounting for the greatest ash level (0.4%). This

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Table 3. Proximate of vegetable wet noodle after addition of different concentration of milkfish skin gelatin.

Proximate (%)	Treatment					
	0 %	0.5%	1%	1.5%	2%	2.5%
Moisture	51.55±0.95^{a}	53.70±0.42^{b}	55.06±1^{b}	56.92±1.76^{c}	58.76±0.54^{d}	59.49±1.16^{d}
Protein	8.29±0.02^{a}	8.4±0.04^{b}	8.55±0.03^{c}	8.73±0.05^{d}	8.84±0.04^{e}	8.92±0.02^{e}
Ash	0.24±0.01^{a}	0.26±0.005^{a}	0.32±0.006^{b}	0.35±0.015^{c}	0.36±0.01^{d}	0.4 0.01^{d}
Lipid	1.82±0.13^{c}	1.64±0.11^{c}	1.42±0.06^{b}	1.24±0.04^{ab}	1.17±0.05^{a}	1.06±0.03^{a}
Carbohydrate	38.09±0.85^{d}	36.00±0.42^{c}	34.66±0.6^{c}	32.75±0.4^{b}	30.87±0.24^{a}	30.13±0.52^{a}

Values are presented as mean±SD. Values with different superscripts within the same column are statistically significantly different ($p<0.05$).

study suggests that adding MSG to wet vegetable noodles increases the mineral content. In comparison to other foods, wet vegetable noodle has a low mineral content. Mineral content of noodle with root and composite tuber flour containing 2.7% ash (Akonor *et al.,* 2017), moringa leaf powder enrichment (Zula *et al*., 2021), noodle from wheat-tigernut pomace mix (Kehinde Oke *et al*., 2022), and mushroom fortified noodle (Parvin *et al*., 2020) have been reported.

The carbohydrate content of wet vegetable noodle with various concentrations of Milkfish skin gelatin exhibited decreasing with addition of more concentration of MSG. Wet vegetable noodle will gelatinize throughout the boiling process. Because gelatinized starch makes water more easily absorbed, the water absorption index (IPA) rises. Amylose and amylopectin are degraded into tiny molecules that are more soluble in water after gelatinization. As a result, the carbohydrate content of the product will drop (Syamsir dan Honestin, 2009). Because the sample was cooked before being examined, the moisture content in wet vegetable noodle was high. The addition of MSG to wet vegetable noodle boosted product moisture content. The maximum moisture content was found at 2.5% concentration. Gelatin can act as a gelling agent and bind water in wet vegetable noodles (Wijana *et al*., 2014).

3.5 Degree of color

Water absorption has a significant effect on products lightness. High levels of lightness (L*) were found in vegetable wet noodle with the addition of 2.5% MSG. The L* value of products was ranged from 56.7 to 70.51 (Figure 3a). The addition of more MSG to wet vegetable noodle resulted in lighter goods (Setiani *et al*., 2013). This study concurred with prior research by Irviani and Nisa (2015). It was considered that the increase in L* was connected to the amount of protein in products (Wang *et al*., 2004). In contrast, the lowest a* and b* values were found in a product containing 2.5% gelatin (Figure 3b and 3c). The a* of wet vegetable noodle was ranged from -5.37 and -1.11 (Figure 3b). The decreased a* value caused by the addition of MSG resulted in a high value of lightness and a low value of redness. The low amount of redness may have resulted by the use of bok-choy extract in the noodle dough or from the protein content of the wet vegetable noodle. The natural pigment of bok-choy most likely influenced the color of vegetable wet noodle. The color chlorophyll will diminish the redness of the noodle.

The b* color of vegetable wet noodle was shown to decrease as a result of adding MSG to the products (Figure 3c). The b* value ranged from 11.56 to 27.55. This result suggested that the vegetable wet noodle was yellow green color. The interaction of gelatin and natural

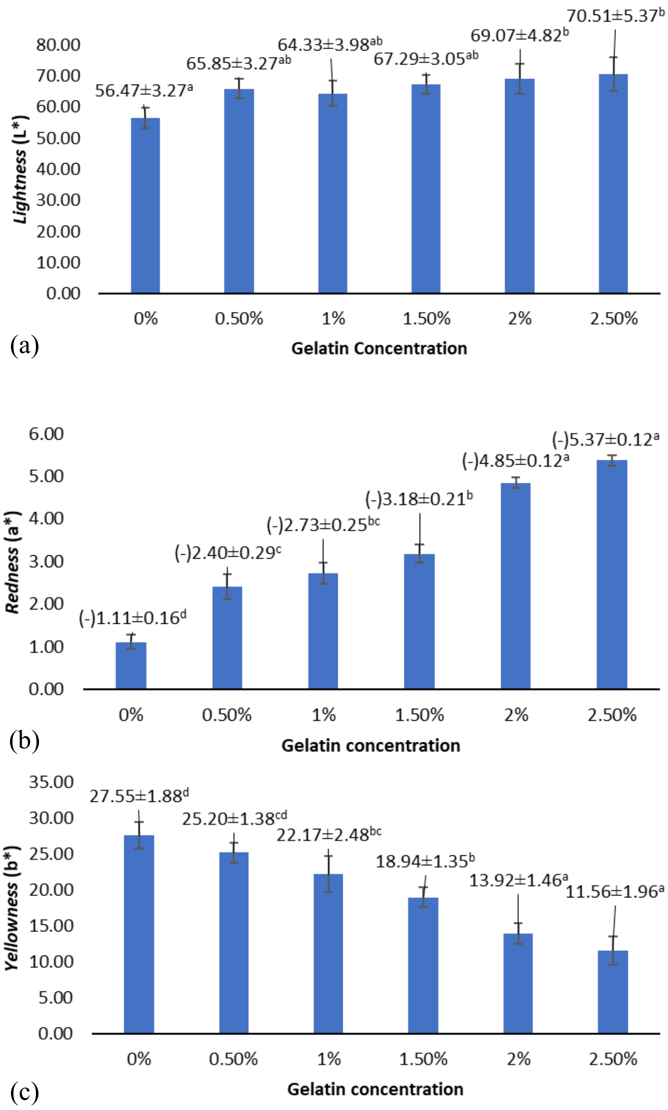

Figure 3. Color measurements of vegetable wet noodles after addition of milk skin gelatin at different concentrations; (a) Lightness (L*), (b) Redness (a*) and (c) yellowness (b*).

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pigment from bok-choy caused the decrease in b* value on the vegetable wet noodle.

3.6 Pigment

The pigment of wet vegetable noodles is related to bok choy extract and gelatin as ingredients In this study, chlorophyll a and b, and carotenoids were spectrophotometrically analyzed. The pigments content in untreated and treated wet vegetable noodles were presented in Table 4. The results showed that the highest levels of chlorophylls and carotenoids were found in vegetable wet noodles after addition with 2.5% milkfish skin gelatin.

3.7 Amino acids

The amino acid concentration of noodles depends on the used ingredients. Vegetable wet noodles are produced from flour, egg and gelatin. Gelatin derived from the skin of milkfish contains different amino acids. High levels of glutamic acid, proline, alanine, and hydroxyproline were found in gelatin (Table 5). Untreated vegetable wet noodle contained high levels of glutamic acids, isoleucine, valine, alanine, arginine, glycine, lysine, aspartic acids, and tyrosine.

3.8 Antioxidant activity

In order to reduce the risk of metabolic syndrome induced by prooxidant, products having antioxidant properties are gaining popularity. Antioxidants are possibly present in food due to functional compounds of ingredients. The bok choy extract in wet vegetable noodles may possess antioxidant properties. Bok-choy is an excellent source of antioxidant components such as anthocyanin, tocopherol, and polyphenol (Shahidi and Zhong, 2015). This study demonstrated that vegetable wet noodles are antioxidant rich. Antioxidant activity varied across all treatments, with the maximum activity seen in the vegetable wet noodle after 1% gelatin enrichment and the lowest in untreated sample (Figure 4). This suggests that MSG had an effect on the antioxidant activity of samples. Gelatin included peptides that can give their proton and react with free radicals to stabilize their surroundings. It is likely that enzymatic extraction of MSG increases the amount of active peptides and free amino acids, hence increasing its antioxidant potential (Baehaki *et al.*, 2015). Size, solubility, composition, and free amino acids will affect a peptide's ability to scavenge DPPH (Bordbar *et al.*, 2013). Additionally, the bioactive content of the bok choy extract affected the antioxidant activity of vegetable wet noodles.

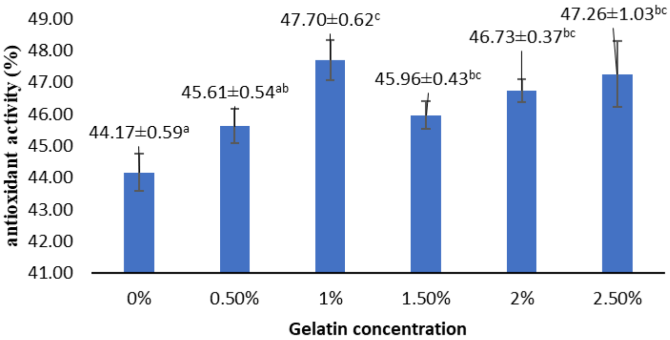

Figure 4. Antioxidant activity of vegetable wet noodle after addition of milkfish skin gelatin at different concentrations. Values are presented as mean±SD. Values with different superscripts are statistically significantly different ($p<0.05$).

3.9 Hedonic analysis

Noodles produced from flour and bokchoy extract with and without MSG exhibited acceptable sensory properties (Table 6). The acceptance of vegetable wet noodle made from various concentrations of MSG was evaluated in this study utilizing multiple sensory criteria such as appearance, texture, flavor, taste, and overall acceptability. General acceptance expresses the panelists' overall opinion of the vegetable wet noodle. Acceptability noodle created from flour, bok choy extract, and MSG promoted the noodle's appearance, taste, flavor, and texture. The treated noodles were preferred over the untreated noodles (Table 6). Noodle appearance and texture have been described as essential parameters of noodle. At concentration 2.5% MSG, vegetable wet noodle is homogeneous in shape and size, not too sticky, and greenish in color, whereas 0% gelatin noodle was sticky and pale in color. The amount of MSG in this study had a significant ($p < 0.05$) effect on noodle appearance (Table 6). The appearance and color of vegetable wet noodle were altered by MSG. Vegetable wet noodle texture scores varied from 6.20 to 8.33, with vegetable wet noodle added with 2.5% MSG obtaining the highest texture score. Because of the thermoreversible gelatin properties, vegetable wet noodle created a chewier texture at this concentration. This

Table 4. Total pigment of vegetable wet noodle after addition of milkfish skin gelatin at different concentrations.

Pigment	Treatment					
	0 %	0.5%	1%	1.5%	2%	2.5%
Chlorophyll a	1.63±0.05^{a}	1.77± 0.05^{a}	2.19±0.02^{b}	2.29±0.02^{b}	2.92±0.13^{c}	3±0.07^{c}
Chlorophyll b	1.57±0.02^{a}	1.63±0.04^{a}	1.81±0.03^{b}	2.01±0.02^{c}	2.52±0.02^{d}	2.46±0.04^{d}
Carotenoids	1.02±0.02^{a}	1.06±0.02^{ab}	1.12±0.03^{b}	1.21±0.03^{c}	1.26±0.03^{cd}	1.32±0.02^{d}

Values are presented as mean±SD. Values with different superscripts within the same column are statistically significantly different ($p<0.05$).

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Table 5. amino acids content in vegetable wet noodle after addition of milkfish skin gelatin at different concentrations.

Treatment	Serine	Glutamic acids	Phenylalanine	Isoleucine	Valine	Alanine	Arginine	Glycine	Lysine	Aspartic acids	Leucine	Tyrosine	Proline	Treo	Histidin
0%	12624.39	47484.45	13349.57	6777.94	7928.34	6473.62	10500.68	8999.73	5385.69	7941.40	13746.97	6125.63	18543.17	8174.38	5061.50
0.50%	12589.09	45691.83	13912.75	6610.58	7725.20	6394.53	9906.90	9411.61	5139.88	7710.15	13433.10	6286.84	18269.12	8400.05	5305.64
1%	11628.98	46415.40	10826.20	6654.98	7793.69	6899.62	8955.87	9455.42	5757.65	7953.07	13588.63	4981.02	18843.05	7297.08	4237.72
1.50%	11710.60	46499.42	10670.37	6541.86	7589.04	7125.40	8999.03	10055.63	5670.06	7911.23	13417.29	4840.35	19024.31	7173.46	4157.04
2%	10992.67	46600.66	9876.09	5948.10	7143.12	7441.38	8496.60	10332.54	5835.52	8458.21	12671.36	4681.04	18784.18	6816.37	3707.34
2.50%	12189.98	42458.84	11493.92	6066.70	7328.10	7431.08	10538.78	12627.21	5377.13	7626.40	12986.57	5588.53	19187.34	7715.98	4282.50

Table 6. Hedonic value of vegetable wet noodle after addition of milkfish skin gelatin at different concentrations.

Treatment	Parameters				
	Appearance	Aroma	Flavor	Texture	Overall
Control	6.47 ± 1.57^{a}	6.13 ± 1.32^{a}	6.80 ± 1.63^{a}	6.20 ± 1.63^{a}	$6.15<\mu<6.65$
0.5%	7.20 ± 1.32^{ab}	7.33 ± 1.42^{b}	7.20 ± 1.49^{ab}	7.53 ± 1.38^{b}	$7.04<\mu<7.60$
1%	7.47 ± 1.46^{b}	6.93 ± 1.57^{ab}	7.53 ± 1.53^{ab}	7.60 ± 1.40^{b}	$7.15<\mu<7.61$
1.5%	7.80 ± 1.24^{bc}	7.27 ± 1.13^{b}	8.20 ± 1.36^{b}	7.93 ± 1.26^{b}	$7.57<\mu<8.03$
2%	7.87 ± 1.46^{bc}	7.07 ± 1.63^{ab}	7.87 ± 1.44^{b}	8.07 ± 1.14^{b}	$7.50<\mu<7.94$
2.5%	8.53 ± 0.86^{c}	7.53 ± 1.46^{b}	8.07 ± 1.57^{b}	8.33 ± 1.09^{b}	$7.86<\mu<8.38$

Values are presented as mean±SD. Values with different superscripts within the same column are statistically significantly different ($p<0.05$).

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result was supported by Kumkong *et al*. (2020).

The flavor of a product is significant in determining its acceptability. The taste scores of the noodle products varied from 6.13 to 7.53, with vegetable wet noodle with 2.5% MSG receiving the highest score. Whereas the aroma score of vegetable wet noodle ranged from 6.80 to 8.20, the maximum aroma score was achieved with vegetable wet noodle enhanced with 1.5% milkfish skin gelatin. The use of milkfish skin gelatin resulted in a fishy aroma on vegetable wet noodle.

4. Conclusion

The results obtained from physicochemical and sensory characteristics of vegetable wet noodle proved that the addition of 2.5 % milkfish skin gelatin produced better characteristics.

Conflict of interest

The authors declare no conflict of interest.

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