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Nutritional Composition and Solubility of Edible Bird Nest (Aerodramus fuchiphagus)

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Abstract. Edible bird nest (EBN) produced by certain swiftlet species mainly, *Aerodromus fuciphagus*. The objectives of this study were to determine and compare the proximate and amino acid composition of EBN obtained from two regions in Peninsular Malaysia (Pahang-A & Terengganu-B). The solubility of edible bird nest with varying pH, temperature and time was also investigated in this study. The results showed that, the EBN contained crude protein accounted to 58.55% (A) and 55.48% (B), carbohydrate at22.28% (A) & 25.79% (B), moisture content 15.90% (A) & 15.87% (B), fat, 0.67% (A) & and 0.29% (B) and ash contents 2.60% (A) & 2.57% (B) respectively. The major amino acids found in edible bird nest EBN were Glutamic acid (9.61%), Aspartic acid (6.34%), Lysine (5.44 %) and also Leucine (5.30%). The total solubility of EBN was also found to be increased when the temperature was increased increase with distilled water yielding the highest total solubility of EBN compared to others buffer (different pH) solutions.

Keywords: Edible bird nests (EBN), proximate, amino acid composition, solubility.
PACS: 80

INTRODUCTION

Aerodromus fuciphagus is one of the swiflet species found in Malaysia. This species produce edible bird nest (EBN) which is a nest made by salivar secretions from a swiftlet's two sublingual salivary glands which is composed almost entirely of a glutinous material [1]. The major component in the nest cement is sialic acid-rich glycoproteins [2]. It has long been used in traditional Chinese medicine and is oftened regarded as a luxury food item. Edible bird nest refers to the nest produced by several different swiftlet species. More than 24 species of insectivorous, ecolocating swiflets are distributed around the world, but only a few produce nests that are deemed 'edible' [3].The nests are built almost exclusively by the 7 to 20 g male swiflet over a period of approximately 35 days.

The major nutrient components of EBN are carbohydrates and glycoproteins as reported by Kathan and Weeks [2], and essential trace elements such as calcium, sodium, magnesium, zinc, manganese and iron [4]. Edible bird nest contains mainly carbohydrates, amino acids and mineral salts. The major ingredients of edible bird nest are glycoproteins [2]. Sialic acid (9%) is the major carbohydrates found in edible bird nest. The other major carbohydrates include 7.2% galactosamine, 5.3% glucosamine, 16.9% galactose and 0.7% fucose [2]. Amino acids and mineral salts are also important components in edible bird nest. Three non-essential amino acids (aspartic acid, glutamic acid, proline) and two essential amino acids (threonine and valine) reported by Kathan and Weeks (1969). Edible bird nest is rich in mineral salts. It contains high content of sodium and calcium. It is because the source of edible bird's nest is derived from limestone caves.

Edible bird nest is not only a medicine to make people healthy but also become a pleasant food [2]. Traditionally, it is double boiled with rock sugar to make a delicacy known as "bird's nest soup" [5]. In spite of the long history of using edible bird nest as cooking material for food and medicinal purposes, there is a limited number of scientific researches relating to its detailed bioactive components and their functional properties.

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MATERIALS AND METHODS

Sample Collection and Materials

Raw cleaned edible bird nest from Pahang and Terengganu were purchased from Nest Excel Resources Sdn. Bhd.in Kuala Lumpur. Edible bird nest were transferred into air tight containers and kept at ambient temperature (25 ^{o}C to 30 ^{o}C) until further analysis.

Proximate Composition

Association of Official Analytical Chemistry methods [6] were employed to determine the moisture, protein, carbohydrate, ash and fat contents of the raw EBN samples. Moisture content was determined by drying the EBN sample in an oven at 105□C until a constant weight was obtained. Crude protein content was determined by Kjeldahl's method, using 6.25 as a conversion factor. Ash content was determined by dry ashing in a furnace at 550 ^{o}C for 18 hours. Crude fat content was calculated from a fraction of lipid extracted from the hydrolysed EBN sample. All EBN samples were undertaken in triplicate and the results were expressed as the percent of dried matter (DM) basis. The available carbohydrate was obtained by the difference method (subtracting the percent of crude protein, fat and ash from 100% dry matter).

Amino Acid Composition

Amino acid compositions of EBN were measured according to Masommeh, 2012 [7]. Dried edible bird nest samples were mix with 6 M hydrochloric acid (HCl) at 110°C for 24 h to hydrolyse the protein. The internal standard a-aminobutyric acid was added to the hydrolysed samples and filtered with a 0.2 mm cellulose acetate membrane filter (Whatman No. 1). The derivatisations of the amino acids were performed at 55 °C for 10 min in a heating block. The separations of the amino acids were performed using a C18 AccQ-Tag amino acid analysis column (3.9 x 150 mm, Waters, USA) with the temperature controlled at 37 °C and a flow rate set at 1 mL/min. The UV detector was operated at 248 nm (for peak identification), and the excitation and emission wavelength for the fluorescence detector was 250 and 395 nm (for amino acid quantification), respectively. The amount of amino acids was calculated, based on the peak area in comparison with that of standard. Alkaline hydrolysis was also done for determination of Trp level.

Total Solubility

Determination of EBN solubility was carried out in aqueous solutions as below (varying pH, temperature and also time).

Preparation of dissolution media buffer (pH solution)

a) pH 4.5 Sodium acetate buffer: Weighed and transferred 2.99g of sodium acetate ($NaC_2H_3O_2$. $3H_2O$) in 1000ml volumetric flask, added 14.0 ml of 2N acetic acid (CH_3COOH) and make up to volume with water (Lakka & Goswami, 2012).
b) pH 6.8 phosphate buffer: Mixed 250ml of 0.2M monobasic potassium phosphate solution, 112ml of 0.2M NaOH into 1000ml volumetric flask and make up with distilled water.
c) pH 7.4 phosphate buffer: Transferred 250ml of 0.2M monobasic potassium phosphate solution, 195.5ml of 0.2M NaOH into 1000ml volumetric flask and make up with distilled water.
d) pH 8.2 coupling buffer: Weighed and transferred 2.1g of Sodium bicarbonate (NaHCO3) 0.1M and 7.3g sodium chloride 0.5M in 250ml volumetric flask and transferred into a beaker.
e) pH 7 (Control): Distilled water.

Sample preparation

Edible bird nest total solubility test was conducted whereby 1g (W1) of dried raw edible bird nest was accurately weighed into 100ml Erlenmayer flask, and 100ml of prepared buffer solution (different pH solution) added into the

flask containing the samples. The flask was coupled into thermostatic shaker waterbath for 4 hours and the temperature was maintained for each treatment. In this experiment, the temperatures varied from 30 to 100°C and five different pH were used (pH 4.5 to pH 8.2). The samples were centrifuged to 5000 rpm for 20 minutes and the supernatant was then filtered using Whatman filter paper No.4 (W2). The filter paper was dried in oven at 100 °C for 16 hours. Weights of dried filter paper (W3) were recorded and the total solubility of edible bird nest was calculated by using Equation below.

$$\text{Total solubility} = \frac{(W3-W2)}{W1} \times 100$$

Statistical Analysis

All analyses were performed in triplicate. Analysis of variance (ANOVA) was performed, and the mean compared, using Duncan's multiple range tests. Statistical analyses were performed using a SAS program (SAS 9.1.3 with SP4 for Windows).

RESULTS AND DISCUSSIONS

Proximate Composition

The results for proximate compositions of the dried edible bird's nest from both region (Pahang, A and Terengganu, B) are shown in TABLE (1).The highest component found in the nests of the two regions was crude protein which is 58.55% (A) and 55.48% (B). These results are quite similar to previous reports that shown crude protein was in a range of 56.2% to 61.5% [8]. In addition, Carbohydrate content of EBN was 22.28% (A) & 25.79% (B) and moisture content was 15.90% (A) &15.87% (B). On the other hand, fat and ash contents are low; 0.67% (A) & 0.29% (B) and 2.60% (A) & 2.57% (B) respectively. Crude fat and ash levels showed the lowest value for proximate composition. This may be due to the composition of the bird nest which is exclusively made out of the saliva and is highly digestible [4]. According to Langham [9], the diets of swiflets are exclusively insects which contain low levels of fat composition in their bodies. Proximate composition reported in this study did not differ significantly ($p>0.05$) for both region.

TABLE (1). Proximate composition of edible bird's nest from Pahang (A) and Terengganu (B).

Sample	A (%)	B (%)	Marcon, 2005[4].	Fucui Ma, 2012[10].	Norhayati et., 2010[8].	Nurul huda et., 2008[11].
Moisture	15.90 ± 0.15^a	15.87 ± 0.12^a	-	7.5–12.9	-	13.77-20.2
Protein	58.55 ± 0.62^a	55.48 ± 3.60^a	62-63	42–63	56.2-61.5	24.36-49.05
Fat	0.67 ± 0.22^a	0.29 ± 0.03^a	0.14-1.28	0.14–1.28	-	0.47-1.99
Ash	2.60 ± 0.23^a	2.57 ± 0.22^a	2.1	2.1–7.3	-	2.75-7.53
CHO	22.28 ± 1.15^a	25.79 ± 3.37^a	25.62-27.26	10.63-27.26	-	27.36-49.05

($P<0.05$). [a] Means between EBN region are not significantly different .

Amino Acid Composition

The differences of amino acid compositions between inedible bird nest, were compared to catfish skin gelatin and catfish (Pangasius sutchi) [7] are shown in TABLE (2) below. Comparison was made to better understand to profile of amino acids among protein sources. The amino acid composition is important in protein because of the nutritional value (essential amino acids) and also has its influential on the functional properties. The major amino acid found in edible bird nest was glutamic acid (9.61%), aspartic acid (6.34%), lysine (5.44 %) and also leucine (5.30%) which is not much differ compared to catfish (*Pangasius sutchi*) . However, no differences in other amino acid was found From TABLE (2), amino acids composition of EBN and catfish (*Pangasius sutchi*) did not show any major different between both of it.

TABLE (2). Amino acid compositions of Edible bird nest compared to catfish.

Amino acid	Edible bird nest (*Aerodromus fuciphagus)*(%)	[7]Catfish (*Pangasius sutchi*) (%)
Aspartic acid	6.3±0.40	5.3±1.5
Serine	2.4±0.14	2.0±0.6
Glutamic acid	9.6±1.13	8.1±2.4
Glycine	2.5±0.20	3.0±1.1
Histidine	1.4±0.07	1.2±0.3
Arginine	3.8±0.52	3.9±1.3
Threonine	2.9±0.06	2.5±0.7
Alanine	3.9±0.27	3.6±1.0
Proline	2.9±0.04	2.2±0.7
Tyrosine	2.9±0.36	1.6±0.4
Valine	3.3±0.28	2.7±0.4
Methionine	2.2±0.16	4.9±1.1
Lysine	5.4±0.66	5.3±1
Isoleucine	3.4±0.16	2.5±0.8
Leucine	5.3±0.52	4.1±1.2
Phenylalanine	2.7±0.08	2.2±0.6
Tryptophan	0.8±0.02	1.2±0.1
Cysteine	1.7±0.07	1.7±0.3

*Values are % of amino acids expressed as mean±SD (n=3).
Masommeh [7].

Total Solubility

FIGURE 1 showed shows that the total solubility values of EBN were minimum at pH 8.2 (alkaline). On the other hand, the total solubility values were maximum at neutral pH (7) in distilled water at all different temperature. At all pH condition, the total solubility increased with increase in temperature. There was not coagulation or aggregation between the protein molecules, possibly because the proteins secondary and tertiary structures unfolded and its unfolding favors the interaction among the hydrophobic groups that contribute to the increasing in total solubility [12]. Results showed there were significant differences between temperatures from 50^{0}C until 100^{0}C at neutral pH (control). From this experiment, distilled water give the highest total solubility compared to others buffer solutions probably due to the uniqueness of glycoprotein structure to bind with water molecule and enhance the solubility of EBN itself.

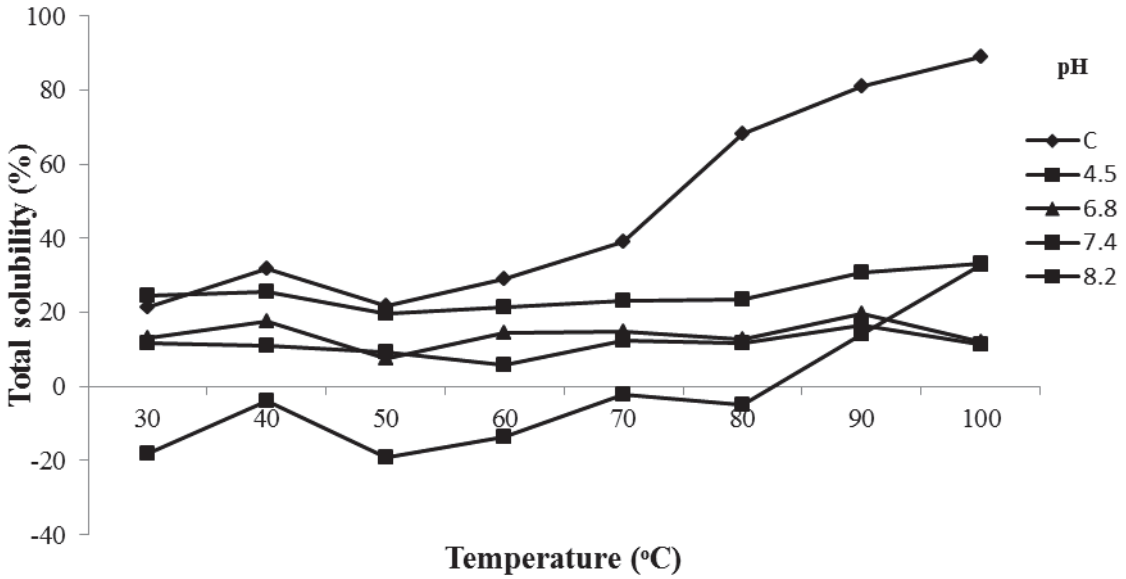

FIGURE 1. Total solubility of edible bird nest at different pH and temperature.

Effects of Time on Solubility of Edible Bird's Nest

TABLE (3) shows the total solubility of edible bird nest as affected by time. The solubility of EBN was measured for 4 hours at 100 ^{o}C in 100ml distilled water. It was observed that the percentage of EBN total solubility increased with time. The total solubility of EBN increased significantly ($P<0.05$) with the time where the protein structure was affected by heating process [12]. From the result, it shows that 4 hours of boiling was give the best solubility on EBN compared to others. Therefore, this can be applied in for the cooking method of traditional "Edible bird nest soup" to enhance their functional role.

TABLE (3). Total solubility of EBN with time.

Time (hour)	Total solubility (%)
1	47.79 ± 1.30^{c}
2	45.83 ± 2.99^{c}
3	58.19 ± 8.26^{bc}
4	70.07 ± 10.57^{ba}
5	74.64 ± 5.01^{a}

($P<0.05$). $^{a-c}$Means between heating time of EBN are significantly different.

CONCLUSION

This study has shown that edible bird nest has a potential to provide good source of protein with good nutritional composition based on the proximate and amino acid composition. It also provided valuable information for edible bird nest solubility property. It was observed that temperature and pH significantly affect edible bird's nest total solubility.

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