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Nutritional Content of Vietnamese Edible Bird's Nest from Selected Regions

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Authors' contributions

This work was carried out in collaboration between all authors. Authors TTML and HMMA conducted literature search, performed all experiments, wrote the protocol and wrote the first draft of the manuscript. Author HLS conceptualized, supervised the study, wrote and revised the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Edible bird's nest is well known as health food and Chinese's traditional medicine. Edible bird's nest is made from saliva secretions of the swiftlets, genus *Aerodramus*, whose habitats are Southeast Asian countries. This study reports on the nutritional content of edible bird's nest of two different sources - house-farmed bird's nest (Long An and Kien Giang Province) and cave bird's nest (Khanh Hoa Province) in Vietnam.
Methodology: Samples were collected from three different selected regions of Vietnam. Determination of protein, lipid and carbohydrate content was performed by AOAC Official Method 2001.12 (2005), AOAC Official Method 986.25 (2012) and FAO (1986), respectively. Meanwhile, Analysis of amino acid was conducted using Shimadzu gas chromatography equipped with flame ionization detector (GC-FID 2010) (EZ: faast™ USER'S MANUAL).
Results: Analytical results showed that the most abundant component found in these edible bird's nests was protein (49.43 - 51.17%), followed by carbohydrate (36.93 - 38.53%), and lipid (0.01 - 0.04%). Fifteen amino acids including seven essential amino acids were found in the house-farmed bird's nest while seventeen amino acids including eight essential were identified in cave bird's nest. Proline (3.68 - 4.69%), aspartic acid (3.58 - 4.52%), and serine (3.74 - 4.09%) were the major amino acids found in both house-farmed and cave bird's nests while lysine was found to be the lowest concentration (0.74 - 0.87%). Methionine and 4-hydroxyproline were presented only in the cave bird's nest.

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Conclusion: These findings indicate that there has been no significant difference in the content of protein, carbohydrate, and lipid ($p > .05$); however, the quality and quantity of some amino acids could be considered to be one of the key factors making the difference ($p < .05$) between house-farmed and cave edible bird's nest.

Keywords: Amino acids; bird's nest; carbohydrate; lipid; protein.

1. INTRODUCTION

Edible bird's nest (EBN) is produced by saliva from two sublingual salivary glands of *Aerodramus* swiftlet. During the breeding and nesting season, the 7 to 20 g male swiftlet conducts the nest in approximately 35 days. Their habitats are only found in the Southeast Asian countries. According to ancient Chinese literature, EBN is used as a food delicacy and an important ingredient in traditional medicine for maintenance of general health, alleviating asthma, and improving the immune system [1]. A previous study reported the presence of epidermal growth factor of EBN [2] which plays a key role in promoting cell division and cell regeneration [3]. In addition, sialic acid found in EBN [4] exhibits the positive effect on inhibition of influenza virus infection [5]. Health benefits of EBN were also reported on many extensive researches such as proliferation of human adipose-derived stem cells [6], Caco-2 cells proliferation [7], and protection of human chondrocytes [8].

EBN is traditionally harvested in the sea caves on the islands and along the coastline (cave bird's nest) whereas the EBN-producing swiftlet houses (house-farmed bird's nest) are established based on the several key factors such as the availability of swiftlet population, feeding zones or physicochemical properties of environment surrounding the houses (humidity, light intensity, temperature, etc.). In the market, cave bird's nest prices are extremely higher than that of house-farmed bird's nest. This might be due to consumers' belief on nutritional values. In relevant research, scientists found that basic nutritional content of EBN are protein (62.0 - 63.0%), carbohydrate (25.62 - 27.26%), and lipid (0.14 - 1.28%) [9]. Recently, several studies have also reported on nutritional content of house-farmed and cave edible bird's nests from certain areas in Thailand, Malaysia and Indonesia [10-11]. It is believed that different nutritional composition of EBN is dependent on the geographical origin, environmental condition, climates and food availability [12]. In Vietnam, there has been little research on nutritional content of EBN and also lacking of study on differentiation between house-farmed and cave bird's nest. In view of these considerations, this study aims to evaluate the major EBN components including protein, carbohydrate, lipid and amino acids from both types of EBN sources - house-farmed and cave bird's nest.

2. MATERIALS AND METHODS

2.1 Sample Collection and Preparation

Samples were collected from three different selected regions of Vietnam. Long An (LA) and Kien Giang (KG) provinces are common sources of house-farmed bird's nest while Khanh Hoa (KH) is famous province for cave bird's nest (Fig. 1). The bird's nests were soaked with distilled water for 30 minutes and passed through the process of feathers and other impurities removal and then air-dried until required for further use.

2.2 Determination of Protein, Carbohydrate and Lipid

EBN protein was digested and distilled using VAPODEST 30s system, and then analyzed by Kjeldahl method as described in AOAC Official Method 2001.12 (2005) [13] while analysis of lipid and carbohydrate were conducted following the protocols given by AOAC Official Method 986.25 (2012) [14] and FAO [15], respectively.

2.3 Determination of Amino Acids

Analysis of amino acid was performed using Shimadzu gas chromatography equipped with flame ionization detector (GC-FID 2010) (EZ: faast^{TM} USER'S MANUAL) [16]. EBN samples were weighed and hydrolyzed by 6 M hydrochloric acid according to the AOAC Official Method 994.12 (2005) [17]. Separation of amino acids was conducted on a capillary column Zebron ZB-AAA GC (10 m x 0.25 mm x 0.25 µm). The operating conditions were as follows: the injection volume was 1 µL, and the flow rate of carrier gas (nitrogen) was at 2 mL/min. The injector temperature was set at 300^0C with a

Fig. 1. Geographical regions (highlight) of sample collection in Vietnam

split ratio of 1:15, and the FID temperature was maintained at 300°C. The oven temperature was programmed from 110°C to 300°C at a rate of 30°C/min and held for 2 min. Amino acids in the samples were identified based on chromatographic comparison between authentic standard and quantified by internal standard solution (Norvaline).

2.4 Statistical Analysis

Data were obtained in triplicate and reported as mean ± S.D. (standard deviation) which was analyzed by R projects for Statistical Computing system package (version 3.5.1). Statistical analysis was performed using the Analysis of Variance (ANOVA) followed by Tukey test. Differences between samples were considered significant when $p < .05$.

3. RESULTS AND DISCUSSION

3.1 Protein, Carbohydrate and Lipid Content

The quantity of protein, lipid and carbohydrate contained in EBN of three selected regions are shown in Table 1. The highest nutritional component found in the EBN of these regions was protein (49.4 - 51.17%), followed by carbohydrate (36.93 - 38.53%). In general, there was no significant difference in EBN components among tested EBN of selected regions. However, in comparison to the results conducted by other researchers using EBN sources from other countries, the protein content of EBN from these regions of Vietnam was significantly lower than that of EBN collected from Malaysia and Indonesia. Studies performed by Marcone (2005) and Hamzal et al. (2013) revealed that protein was the most abundant EBN component accounted for 62.0 - 63.0% and 59.8 - 65.8%, respectively. On the contrary, carbohydrate content was determined significantly higher than that of Marcone's (25.62 - 27.26%) and Hamzal et al.'s findings (8.5% to 16.4%). Meanwhile, the low amount of lipid content has been observed with all tested EBN of different sources, both domestics and foreign regions. The highest percentage of lipid content has been found in the range of 0.14 – 1.28% by Marcone's research (2005) whereas the extremely low concentration of lipid content has been marked in EBN of three selected regions (0.01 - 0.04%). Likewise, the same trends have been noted by Hamzal et al. (2013) as the lipid content was determined between 0.01 and 0.07%.

3.2 Amino Acid Content

Identification and quantification of amino acids in EBN of each region are shown in Table 2 and Fig. 2 (A, B, and C). Fifteen amino acids including seven essential amino acids (histidine, isoleucine, leucine, lysine, phenylalanine, threonine, and valine) were found in the house-farmed bird's nest, meanwhile seventeen amino acids including eight essential amino acids (histidine, isoleucine, leucine, lysine, phenylalanine, threonine, valine and methionine) were identified with cave bird's nest. The major

amino acids found in the tested EBN were proline (3.68 - 4.69%), followed by aspartic acid (3.58 - 4.52%) and serine (3.74 - 4.09%) whereas lysine was recognized as the amino acid with the lowest amount (0.74% - 0.87%) contained in these EBN of selected regions. In general, there was not much significantly different to EBN amino acid content of selected

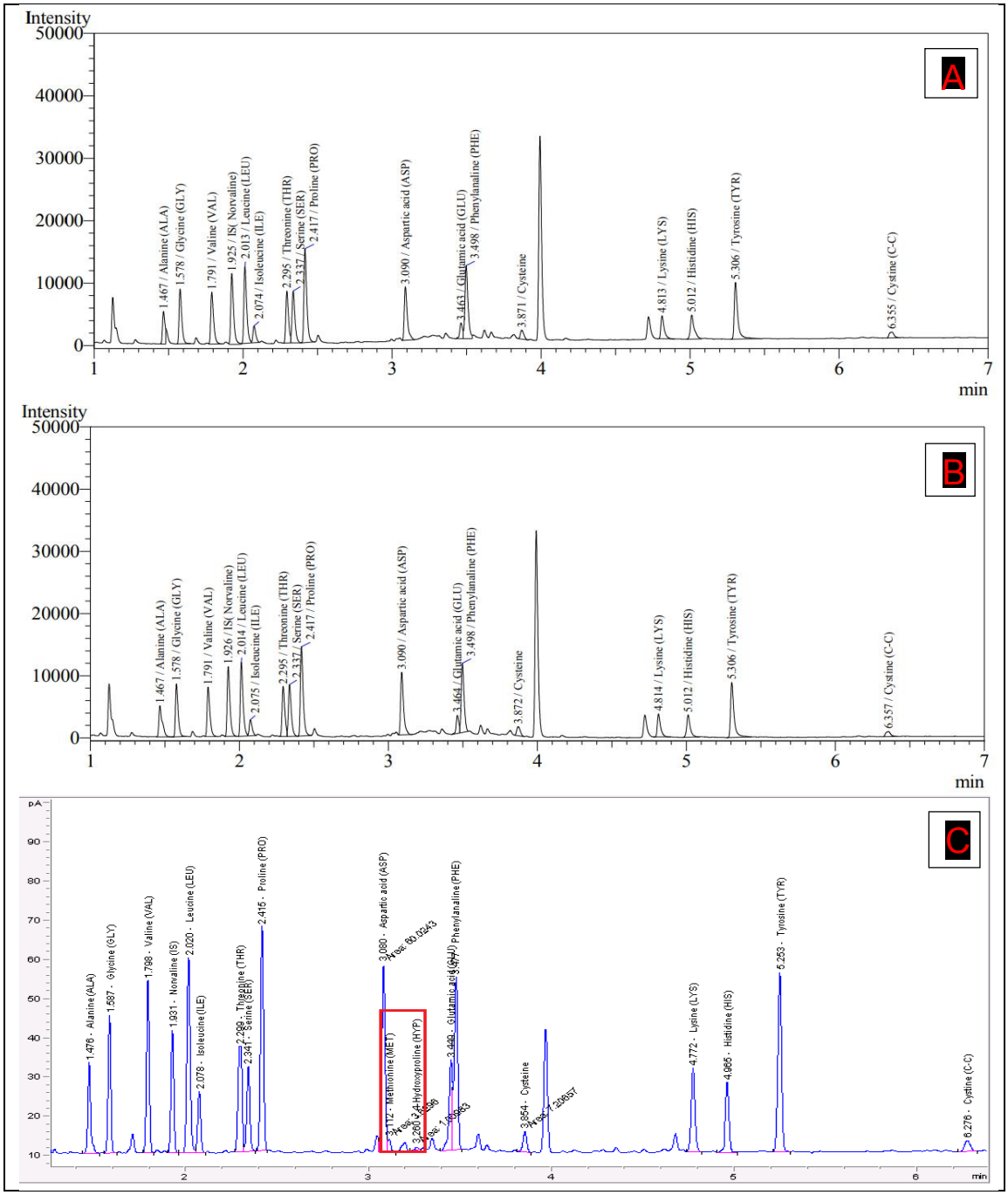

Fig. 2. Chromatogram of amino acid content from EBN of three selected regions (A: Long An, B: Kien Giang, and C: Khanh Hoa). Methionine and 4-hydroxyproline (red square) were only presented in cave bird's nest from Khanh Hoa

Table 1. Nutritional content of EBN from house-farmed (LA, KG) and cave (KH)

Component (%)	House-farmed EBN from LA	House-farmed EBN from KG	Cave EBN from KH
Protein	50,43 ± 3.03*	49.43 ± 2.66*	51.17 ± 3.18*
Carbohydrate	37.87 ± 1.76*	38.53 ± 1.25*	36.93 ± 2.05*
Lipid	0.01 – 0.02*	0.01 – 0.03*	0.02 – 0.04*

**Values in each sample are not significantly different (p > .05)*

Table 2. Amino acid content of EBN from house-farmed bird's nest (LA, KG) and cave bird's nest (KH)

Amino acid (%)	Region		
Essential	**LA**	**KG**	**KH**
Histidine	1.75 ± 0.26[a]	1.91 ± 0.18[a]	2.08 ± 0.29[a]
Leucine	3.01 ± 0.18[a]	3.22 ± 0.74[a]	3.27 ± 0.53[a]
Isoleucine	1.12 ± 0.10[a]	1.19 ± 0.25[a]	1.61 ± 0.09[b]
Methionine	Not found	Not found	0.24 ± 0.11[b]
Lysine	0.74 ± 0.15[a]	0.74 ± 0.22[a]	0.87 ± 0.16[a]
Phenylalanine	2.62 ± 0.17[a]	3.09 ± 0.42[a]	3.87 ± 0.47[a]
Threonine	2.99 ± 0.24[a]	3.22 ± 0.76[a]	3.61 ± 0.48[a]
Valine	2.89 ± 0.38[a]	3.06 ± 0.44[a]	3.64 ± 0.37[a]
Non – essential			
Glycine	1.63 ± 0.19[a]	1.71 ± 0.20[a]	1.91 ± 0.19[a]
Alanine	1.10 ± 0.17[a]	1.62 ± 0.12[b]	1.44 ± 0.10[ab]
Aspartic acid	3.58 ± 0.64[a]	4.52 ± 0.62[a]	4.47 ± 0.62[a]
Glutamic acid	2.62 ± 0.17[a]	3.09 ± 0.42[ab]	3.87 ± 0.47[b]
Serine	3.74 ± 0.33[a]	4.09 ± 0.50[a]	3.99 ± 0.61[a]
Proline	3.68 ± 0.37[a]	3.91 ± 0.13[a]	4.69 ± 0.34[b]
4-hydroxyproline	Not found	Not found	0.34 ± 0.05[b]
Cysteine	2.76 ± 0.53[a]	2.72 ± 0.36[a]	3.16 ± 0.76[a]
Tyrosine	1.70 ± 0.30[a]	1.58 ± 0.22[a]	1.86 ± 0.35[a]

Values in category row with the same letter are not significantly different (p > .05)

regions, except for isoleucine and proline. It should be noted, however, methionine and 4-hydroxyproline were only presented in the cave bird's nest with little amount (0.24 and 0.34%, respectively) (Fig. 2) while these two amino acids were absolutely not found from both house-farm bird's nests (Long An and Kien Giang) which might be suggested as one of the main factors contributing to the difference between house-farmed and cave bird's nests.

4. CONCLUSION

Cave bird's nest and house-farmed bird's nest of selected regions of Vietnam did not differ significantly on the basic nutritional composition with regards to the content of protein, carbohydrate, and lipid. However, the quality and quantity of some amino acids, particularly the presence of methionine and 4-hydroxyproline only in cave bird's nest could be considered to be the key point to remark the difference between EBN of two different sources – house-farmed and cave bird's nest. Future work should be the qualitative and quantitative assessment of functional components such as epidermal growth factor and sialic acid in EBN of different regions, both house-farmed and cave bird's nest.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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