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Preliminary Study of the Nutritional Content of Malaysian Edible Bird's Nest

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ABSTRACT

Malaysian edible bird's nests (EBN) are from the swiftlet species, *Aerodromus fuciphagus.* The objective of this study was to determine and compare the nutrient composition of EBN obtained from different parts of Peninsular Malaysia, collected at three different harvesting seasons, to four commercial brands. A total of 18 raw, unprocessed EBN samples from the North, South and East Coast zones of Peninsular Malaysia and duplicate samples of 4 commercial brands (processed) of EBN samples were analysed. The protein and mineral contents of unprocessed EBN samples between zones and harvesting seasons were comparable. Mean (± SEM) protein content of unprocessed EBN was 61.5 ± 0.6 g/100g and the top four minerals detected were calcium, sodium, magnesium and potassium with mean (± SEM) concentration of 553.1 ± 19.5 mg/100g, 187.9 ± 10.4 mg/100g, 92.9 ± 2.0 mg/100g and 6.3 ± 0.4 mg/100g respectively. Sialic acid content ranged between 0.7 to 1.5%, and remained comparable between samples from different zones and harvesting seasons. The commercial brands were found to contain higher amounts of calcium, sodium, magnesium, potassium and phosphorus compared to unprocessed EBN, warranting further investigation and verification with more samples. Since the nutrient contents of EBN may be affected by seasonal variations and even breeding sites, it is recommended that a more comprehensive study be conducted involving more samples and breeding sites as such data are important to ensure sustainability of the EBN industry in this country.

Keywords: Edible bird's nest, Malaysia, protein, minerals, sialic acid

INTRODUCTION

Edible bird's nests (EBN) found in Malaysia are from the swiftlet species, *Aerodromus fuciphagus.* Their size is about that of a sparrow with wingspan wider than that of a pigeon. Swiftlets feed on insects caught in flight such as from the order *Hymenoptera* (winged ants, fig wasps and bees), *Diptera* (flies), *Coleoptera* (small beetles), *Homoptera* (leafhoppers) and *Ephemenoptera* (mayflies) (Lim & Cranbrook, 2002). They construct their nests with glutinous strands of starch-like saliva produced by a pair of large, salivary glands under their tongue and thereafter mate and breed their young in the nest (Goh *et al.*, 2001). The first breeding season usually begins in December and

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continues through March followed by April to July and then August to November (Lim & Oswald, 2004).

Traditionally used as a food delicacy, EBN is also an important ingredient in traditional Chinese medicine for health-enhancing effects ranging from enhancing complexion, alleviating asthma, and strengthening the immune system (Lim & Cranbrook, 2002). EBN extract has been shown to stimulate mitosis hormones and the growth factor for epidermal growth (Kong *et al.*, 1987; Ng, Chan & Kong, 1986) and is known to have exerted strong inhibitory effect on influenza viruses in a host range-independent manner (Guo *et al.*, 2006). The major nutrient components of EBN are carbohydrates and glycoproteins (Kathan & Weeks, 1969), and essential trace elements such as calcium, sodium, magnesium, zinc, manganese and iron (Marcone, 2005). Despite the many health claims associated with EBN consumption, the mechanism of action is unknown and there is no clinical evidence to support those claims. In a recent report, the carbohydrate in EBN was found to contain among others, sialic acid and glucosamine (Tung *et al.*, 2008). While sialic acid has been associated with enhanced brain functions in infants (Colombo *et al.*, 2003), the presence of glucosamine could perhaps explain some of the immuno-modulating effects of EBN.

High in demand and highly priced in the global market, EBN cultivation has increased dramatically in EBN-producing countries including Malaysia (Hobbs, 2004). The main areas of EBN cultivation in Peninsular Malaysia are Sitiawan, Teluk Intan, Kota Bharu, Kuala Terengganu, Parit Buntar, Bukit Mertajam, Nibong Tebal, Kuantan, Muar, Segamat and many other old townships (Burhanuddin, 2004). Hence efforts have been made by the Department of Wildlife and National Parks (PERHILITAN), Ministry of Natural Resources and Environment, Malaysia to increase the number of producers and at the same time, ensure that the quality, especially the nutritional contents of this commodity is maintained. The objective of this study, which was carried out in collaboration with PERHILITAN, was to determine whether breeding places and harvesting seasons could affect the nutritional contents of Malaysian EBN.

MATERIALS AND METHODS

Materials

A total of 18 unprocessed EBN samples from 3 zones in Peninsular Malaysia; North (Kedah, Pulau Pinang, Perlis and Perak), South (Johor, Malacca and Negeri Sembilan) and the East Coast (Pahang, Terengganu and Kelantan) and duplicate samples of 4 different brands of processed EBN samples (dried and in the shape of a natural nest) were supplied by PERHILITAN. For this preliminary report, the brand names of the processed EBN samples will not be revealed.

Preparation of samples

All nests were cleaned by soaking in water to soften nest cement. Feathers and fine plumages were manually removed with forceps. The nests were allowed to dry in an oven at 60^{o}C for 5 days and then finely grounded using a food grinder. The finely grounded EBN samples were transferred into air tight containers and kept at ambient temperature until further analysis.

Protein analysis

Protein analysis was performed using Kjeldahl method, as prescribed in FOSS Analytical AB (2003) Aplication Note, using the Tecator Kjeltec System. Briefly, finely grounded EBN sample (0.1g) was digested with 12 ml concentrated sulphuric acid in the presence of a catalyst (3.5g potassium sulphate, 0.4g copper sulphate).

Minerals (Ca, P, Fe, Na, K, Mg, Cu and Zn) analysis

For mineral analysis, 1.0 g of oven dried nest from ash determination was digested in concentrated hydrochloric acid as described by Tee *et al. (*1996). The elements, Ca, Fe, Na, K, Mg and Zn were measured by atomic absorption spectrophotometry (Atomic absorption spectrophotometer model GBC 940 AA). Phosphorus (P) was measured spectrophotometrically at 420 nm using Shimadzu UV 120-01. Present as orthophosphate, phosphorous reacted with a vanadate-molybdate reagent to produce a stable yellow-orange complex of vanadi-molybdisphoshoric acid.

Sialic acid analysis

The sialic acid analysis was performed as described in Dionex Technical Note 41 with slight modifications. The sialic acid content was analysed using Agilent 1200 Series HPLC with ESA Coulochem®III electrochemical detector. The separation was performed on CarboPac PA20 column (3 X 150mm) with gradient elution of 100 mM Sodium hydroxide and 100 mM sodium hydroxide / 1 M Sodium acetate. Sialic acid in EBN was extracted by hydrolysis method using 0.1M hydrochloric acid followed by incubation at 80^0C for 1 hour. The hydrolysate was subjected to vacuum drying to remove traces of HCl solution. Dried hydrolysate powder was then re-dissolved in about 1000 μl of ultrapure water, filtered with 0.22 micron nylon membrane filter and then subjected to HPLC analysis.

Statistical analysis

A Statistical Package for Social Science (SPSS) for Windows version 11.5 was used to analyse the data. All results are reported as mean ± SEM.

RESULTS

Unprocessed EBN samples

Although it could not be confirmed statistically due to the small sample size, there seemed to be seasonal variations in the amount of protein present in the EBN samples collected from the 3 zones at different seasons (Figure 1). Protein content ranged from 60.3 to 63.6 g / 100g, 61.8 to 65.2 g / 100g and 57.9 to 61.2 g / 100g for samples obtained from the North, South and East Coast Zones respectively. For the North and East Coast Zones, the highest protein level was found in samples collected during December to March, while for the South Zone, samples harvested during August to November had the highest protein content.

The mineral contents of unprocessed EBN obtained from different zones and harvesting seasons are as shown in Table 1. The order of highest to lowest level of minerals detected was found to be similar for all zones; highest being calcium with content ranging from 467.8 to 673.4 mg / 100g. Due to the small sample size, no statistical comparison could be made to determine whether the amount of minerals present in the unprocessed EBN samples was affected by breeding sites and harvesting seasons. Sialic acid content ranged between 0.7 to 1.5%, and remained comparable between samples from different zones and harvesting seasons.

Commercial EBN samples

The protein, minerals and sialic acid contents of four commercial EBN samples are shown in Table 2. The amount of protein present in the commercial EBN samples was comparable to the mean protein content of unprocessed EBN samples. The level of calcium detected in the commercial EBN samples varied according to brands.

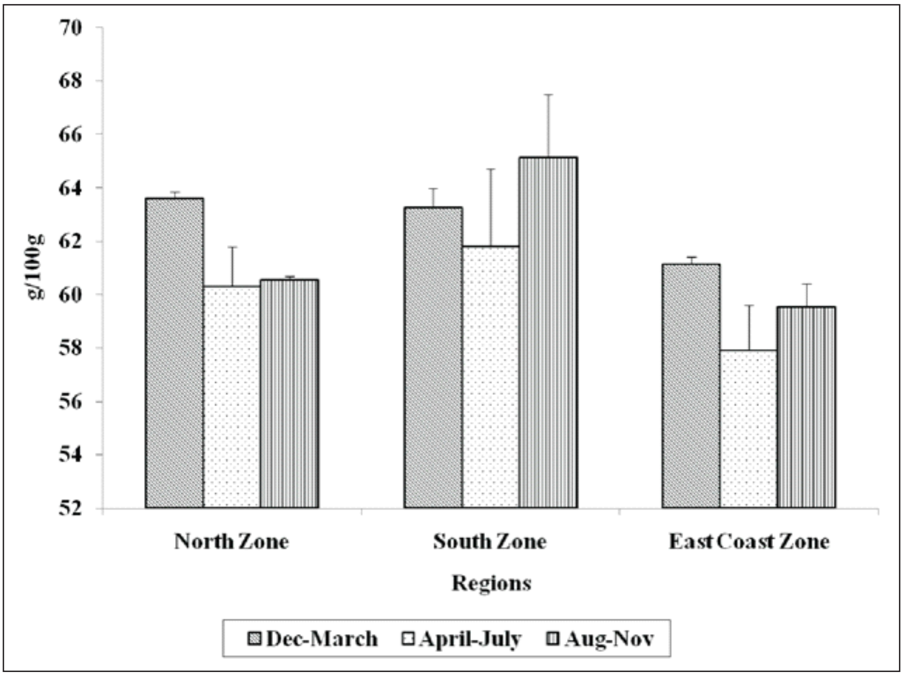

Figure 1. Mean ± (SEM) crude protein content of unprocessed EBN samples according to harvesting season and region

Calcium content in Brands A and B was comparable to that detected in unprocessed EBN samples but for Brands X and Y, the levels were four-fold higher. On the other hand, Brands A and B contained much higher levels of sodium, potassium and phosphorus compared to the other two brands and the unprocessed EBN samples.

DISCUSSION

One of the basic requirements for swiflets habitat and productivity is their food source. Swiflets feed on insects from species *Hymenoptera* (winged ants, fig wasps and bees), *Coleoptera* (small beetles), *Homoptera* (leafhoppers) and *Ephemenoptera* (mayflies). It has been reported that nests harvested during the rainy season when food is most abundant, are the most expensive because they are big and thick, highly swollen and contained fewer impurities (Azman, Siti Hawa & Norazlinda, 2004). Similar observations were also reported in Indonesia where the quality of EBN depended on the habitats and the best harvests were found to be during the early and late raining seasons (Ani Mardiastuti & Boedi, 2004). In Peninsular Malaysia, maximum rainfall for the East coast states usually occurs in the months of November till January while, in the western part of the country, the rainy season normally occurs between October to November or December. As shown in this study, unprocessed EBN samples harvested during the raining seasons had higher amounts of protein compared to those collected in the other two seasons. The overall mean protein content of 61.5% for the unprocessed EBN samples analysed in this study was comparable to that reported by Marcone (2005) who also studied EBN samples from Malaysia. In contrast, EBN samples obtained from several locations in

Table 1. Mean (SEM) concentration of minerals and sialic acid in unprocessed EBN samples according to zones and harvesting seasons

	North Zone			*South Zone*			*East Coast Zone*		
	Dec-March (n=2)	*April-July (n=2)*	*Aug-Nov (n=2)*	*Dec-March (n=2)*	*April-July (n=2)*	*Aug-Nov (n=2)*	*Dec-March (n=2)*	*April-July (n=2)*	*Aug-Nov (n=2)*
Minerals (mg / 100g)									
Calcium	616.1(31.9)	673.4(130.0)	514.0(46.5)	569.7(10.8)	563.8(18.6)	467.8(57.0)	508.3(26.3)	572.5(0.6)	492.5(15.3)
Sodium	208.5(3.7)	154.6(66.1)	210.1(38.6)	209.7(8.9)	189.7(31.2)	189.8(64.1)	202.2(18.6)	183.9(21.9)	142.8(0.8)
Magnesium	93.3(8.3)	97.8(5.2)	96.0(9.1)	97.1(4.5)	99.1(8.0)	82.8(2.1)	88.7(1.9)	94.5(5.6)	86.7(7.8)
Potassium	5.6(0.3)	6.7(0.1)	6.9(2.1)	5.0(0.5)	6.2(1.4)	5.7(1.0)	6.5(1.4)	8.0(1.9)	6.4(0.4)
Phosphorus	1.8(1.0)	1.1(0.6)	5.2(3.1)	2.0(0.7)	2.0(0.2)	4.6(2.7)	0.9(0.6)	0.5(0.0)	3.0(1.6)
Iron	1.1(0.3)	0.9(0.1)	2.0(1.1)	0.8(0.2)	1.4(0.0)	1.4(0.4)	1.2(0.2)	1.2(0.5)	1.0(0.1)
Zinc	0.8(0.0)	0.9(0.2)	0.9(0.3)	0.7(0.1)	0.9(0.1)	1.5(0.5)	0.9(0.4)	1.0(0.3)	1.0(0.2)
Copper	0.5(0.0)	0.6(0.1)	0.5(0.1)	0.6(0.1)	0.6(0.0)	0.5(0.1)	0.6(0.1)	0.5(0.1)	0.4(0.1)
Glycoprotein (%)									
Sialic Acid	0.8(0.0)	1.5(0.6)	0.7(0.1)	0.8(0.0)	0.7(0.7)	0.7(0.2)	0.8(0.2)	0.3(0.3)	0.4(0.0)

Table 2. Mean (SEM) concentration of protein, minerals and sialic acid in processed EBN samples

	Brand X (n=2)	*Brand Y (n=2)*	*Brand A (n=2)*	*Brand B (n=2)*	*Unprocessed EBN (n=18)*
Crude Protein (g/100g)	58.7(2.8)	56.2(0.7)	61.5(4.0)	56.7(0.2)	61.5(0.6)
Minerals (mg/100g)					
Calcium	2071.3(37.4)	2071.3(16.3)	503.6(4.9)	524.8(5.7)	553.1(19.5)
Sodium	110.8(2.2)	39.8(0.9)	509.6 (4.7)	505.9(0.2)	187.9(10.4)
Magnesium	79.0(0.4)	67.5(2.1)	97.0(1.0)	99.6(1.2)	92.9(2.0)
Potassium	7.0(0.7)	33.7(3.7)	107.2(0.1)	75.2(8.8)	6.3(0.4)
Phosphorus	4.1(0.1)	4.2(0.5)	12.5(1.9)	7.7(0.5)	2.3(0.5)
Iron	2.9(0.3)	2.2(0.7)	0.9(0.2)	2.0(0.7)	1.2(0.1)
Zinc	1.3(0.0)	1.0(0.0)	1.4(0.6)	0.7(0.1)	0.9(0.1)
Copper	0.4(0.0)	0.4(0.0)	0.4(0.0)	0.3(0.0)	0.5(0.0)
Glycoprotein (%)					
Sialic Acid	ND	1.5(0.9)	0.7(0.2)	0.7(0.2)	0.7(0.1)

ND - not detactable

Penang were found to contain less protein, ranging between 24 to 49% (Nurul Huda *et al.*, 2008). The reason for this difference could not be explained but it may be possible that as Penang is a more industrialised state, the clearing of forest for development could have had an impact on the diversity of insects and hence reduction in food supply for the swiflets as proposed by Burhanuddin (2004).

Due to the high retail price per kilogram of this commodity, there have been several reported cases of adulteration with less expensive materials, usually incorporated during the processing stages in an effort to increase the net weight or nutrient content prior to sale. (Goh *et al.*, 2001; Law & Melville, 1994). Among the more common adulterants found in retail EBN are karaya gum, red seaweed and Tremella fungus (Marcone, 2005) but in a recent report, even pork skin had been detected in EBN products (Tung *et al.*, 2008). Due to their similarity in color, appearance, taste and texture to the EBN material, detection has been difficult. Using crude protein determination, it was found that these adulterants which typically accounted for 2-10% of the finished product, could reduce the overall crude protein content of the genuine EBN by as much as 1.1- 6.2% (Marcone, 2005).

The presence of sialic acid in EBN, reported to be about 9% (Kathan & Weeks, 1969), has been widely used by retailers to promote and sell their EBN. Results of past studies that showed the association of sialic acid supplementation with improvement in neurological and intellectual development of infants (Colombo *et al.*, 2003) and enhancement in the viscosity of mucus to prevent bacterial and viral infection (Alessandri *et al.*, 1990) are often quoted in product inserts to convince the consumers. On the contrary, none of the EBN samples, including the commercial samples analysed in this study contained such high amounts of sialic acid.

Another important finding of this study which may be of health concern, was the high level of minerals detected in the four different brands of processed EBN compared to the unprocessed samples. Whether this was naturally present or due to adulteration needs to be further investigated and verified with more samples. While calcium is important for bone development, nerve transmission, regulation of heart muscle function and serves as required co-factor for several enzymatic reactions in the human body (Mahan & Escott-Stump, 2000), consumers should be protected as excessive intake of minerals can be detrimental to health (Wooltorton, 2003).

In conclusion, this study has shown that EBN is a good source of protein and minerals and its consumption may have some nutritional benefits. However, since the nutrient contents may be affected by seasonal variations and even breeding sites, it is therefore recommended that a more comprehensive study be conducted involving more samples and breeding sites in order to confirm the present findings, and more importantly, gather relevant data to ensure the sustainability of the EBN industry in this country.

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