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Research Article

Swiftlet Bird's Nest (*Collocalia fuciphaga*) from West Sumatra as a Functional Food and Its Nutritional Content

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ABSTRACT

Functional foods contain biologically active components and compounds that have physiological effects on the human body, such as promoting health and decreasing the risk of sickness. The swiftlet, which belongs to the *Collocalini* family, is an insect-eating bird that migrates across the Indian Ocean, Southeast Asia, and northern Australia to the Pacific Ocean. Swiftlet bird's nests (SBN) contain protein, fats, carbohydrates, iron, calcium, phosphorus, inorganic salts, fiber, and water. The objective of this study is to determine the nutritional content of swiftlet bird nests in different regions of West Sumatra. Samples of swiftlet bird's nests (SBN) were collected from Padang City (PD), Bukittinggi City (BK), and Pesisir Selatan Regency (PS). Nutritional content was analyzed using proximate methods, including moisture, protein, and fat, and the nitrite concentration was measured using UV-Vis spectrophotometry. The study found that SBN in West Sumatra contains 47.65–50.55% protein, 1.48–2.47% fat, 21.77–22.77% water, and 24.75–32.72 ppm nitrite. The results indicate that the nutritional content varies among the samples, and the protein content found in SBN is higher, making it suitable for use as a functional food. Additionally, SBN has many health benefits and biological activities, such as mitogenic response and cell growth, enhanced immunity, and improved bone strength.

Keywords: functional food, nitrite, nutritional content, proximate, swiftlet bird nest

INTRODUCTION

Food is a fundamental and indispensable constituent of the persistence of life, necessitating its ingestion to maintain the existence of human beings. The central role of food lies in its provision of energy and constituent elements, which serve to rejuvenate and sustain the optimal functionality of our physical forms. However, it is important to note that functional food, in contrast, is consumed for purposes beyond mere nourishment (Hasler, 2002). These functional foods include physiologically active ingredients and compounds that trigger physiological effects on the human body, therefore boosting general well-being and lowering the risk of sickness (Aguiar *et al*., 2018).

The swiftlet, a member of the *Collocalini* family, is an insect-eating bird that migrates from the Indian Ocean to the Pacific Ocean via Southeast Asia and northern Australia. Only four species of swiftlets of the *Collacalia* genus, which live in Southeast Asia, are economically

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valuable owing to human eating. These species are known as *Collocalia fuciphaga*, *Collocalia germanis, Collocalia maximum*, and *Collocalia unicolor*. *Collocalia fuciphaga* (white nest) and *Collocalia maxima* (black nest) birds make excellent bird nests with their saliva. *Collocalia fuciphaga* is normally found in limestone caverns, but it has been successfully cultivated in human settings since 1880. The predominant swiftlet nest production in Indonesia occurs in Central Java, followed by East Java and West Java (Mardiastuti, 1997).

The nest of the swiftlet bird is highly valued for its multiple benefits and exceptional taste. Within the Chinese culture, it is thought to contribute to health by acting as an anti-aging agent and enhancing the immune system. Aside from its medical properties, the swiftlet bird's nest is regarded as a delectable culinary component. The traditional method involves simmering the nest with rock sugar to create a tasty stew known as bird's nest soup (Chan, 2010).

Swiftlet bird's nests (SBN) contain protein, fats, carbohydrates, iron, calcium, phosphorus, inorganic salts, fiber, and water (Nugroho and Budiman, 2009; Hamzah *et al*., 2013). Swiftlet bird nests include phytonutrients such as sialic acid (9%), N-acetylgalactosamine (galNAc) (7.2%), N-acetylglucosamine (glcNAc) (5.3%), galactose (16.9%), and fructose (0.7%) (Aswir and Nazaimoon, 2011; Rashed and Nazaimoon, 2010). Marcone (2005) reported that the chemical content of both white and black swiftlet bird nests is the same. The fat content ranges from 0.14% to 1.28%, the ash content is 2.1%, the carbohydrate level varies from 25.62% to 27.26%, and the protein content is from 62% to 63%. (Marcone, 2005). However, there is currently little research on the nutritional composition of swiftlet bird nests discovered in West Sumatra. As a result, the purpose of this study is to investigate the nutritional value of swiftlet bird nests in various parts of West Sumatra, as well as their potential as a functional food.

MATERIAL AND METHODS

Sample Collection

Samples of swiftlet bird's nests (SBN) were collected from three regions in West Sumatra, namely Padang City (PD), Bukittinggi City (BK), and Pesisir Selatan Regency (PS). These three samples were collected from SBN farmers.

Proximate Analysis

Protein Content Analysis

Total protein content analysis was measured by the Kjeldahl method (Sudarmadji *et al*., 1997). A sample of 0.5 grams of SBN was placed in a Kjeldahl flask, to which 10 ml of concentrated H_2SO_4 and 0.5 grams of selenium were added. The mixture was then subjected to destruction until the appearance of a clear green color, followed by distillation. The resulting distillate was subsequently titrated with 0.1 N HCl until a purple color change was observed, including the blank form. The obtained result was expressed as a percentage.

Fat Content Analysis

Fat content was determined using the Soxtec method (Association of Official Analytical Chemists, 2005). SBN samples were measured to an approximate mass of 0.20 g, and the solvent petroleum ether was utilized for the extraction process, employing a volume of 4 mL. Initially, the amalgamation was made uniform through the application of an ultrasonic homogenizer, specifically the Fisherbrand Model 505 Sonic Dismembrator, originating from Thermo Fisher Scientific in Malaysia. Subsequently, the concoction was subjected to filtration utilizing a Buchner funnel. The resulting filtrate was then transferred into a separating funnel, where it

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underwent agitation with a volume of 20 mL of distilled water. A period of overnight settling was granted to the mixture, after which the solvent was eliminated and subsequently desiccated within an oven maintained at a temperature of 60°C over 8 hours. Subsequently, the remaining weight was identified as the fat content, quantified as a proportion.

Moisture Content Analysis

Moisture content was measured by the drying-oven method (Association of Official Analytical Chemists, 2005). As much as 2 grams of SBN samples were prepared and placed within a porcelain cup, which had its empty weight measured using an analytical balance. Subsequently, each sample and cup was introduced into the oven and subjected to a drying process at a temperature of 105°C for 4 hours. Once the 4-hour mark was reached, the sample was extracted from the oven and subsequently placed in a desiccator for 15 minutes. Following this, the sample was weighed using an analytical balance. The water content was determined by calculating the difference in weight between the samples before and after the drying process. This difference was then divided by the weight of the sample and subsequently multiplied by 100% to obtain the final water content value.

Nitrite Content Analysis

Nitrite concentration was assessed through the utilization of a UV-VIS spectrophotometer (SHIMADZU Model No: UV-2550, Japan). Nitrite standard, namely NaNO2, was employed for this purpose. The nitrite was ascertained by diazotizing 50 ml of water-dissolved SBN samples with 1 mL of sulfanilamide and subsequently coupling with 1 mL of N-(1-naphthyl)-ethylenediamine dihydrochloride, resulting in the formation of a highly colored azo dye. The resultant color was gauged at a wavelength of 540 nm.

RESULTS AND DISCUSSION

Proximate Content

Table 1. Proximate content of swiftlet bird nest (SBN) from several regions in West Sumatera

SBN Sample	Proximate Content (%)		
	Protein	Moisture	Fat
PD	47.95	21.77	1.48
BK	50.55	22.77	2.47
PS	49.62	22.62	1.82

PD = Padang, BK = Bukittingi and PS = Pesisir Selatan

Based on Table 1, the protein, which is the most prominent component, was determined to have a range of 47.65 to 50.55% (with an average of 49.37%). The greatest and the smallest protein content was observed in SBN from BK (50.55%) and PD (47.65%). These findings, as predicted, indicated that SBN protein content is affected by geographical location. However, the protein content in this research was lower than that of SBN gathered in Thailand, which varied from 60.9 to 66.9% (average of 62.58%) (Saengkrajang *et al*., 2013); Malaysia (Pahang and Terengganu), which ranged from 58.55 to 55.48% (average 57.01%) (Halimi *et al*., 2014); Malaysia (Perlis and Langkawi), and Indonesia (Java, Kalimantan, Balikpapan), which ranged from 59.8 to 65.8% (average 62.8%) (Hamzah *et al*., 2013) but higher than SBN were collected in Malaysia (Penang), which ranged from 24.36 to 49.29 (average 41.19%) (Huda *et al*., 2008).

Elfita *et al*. (2020) discovered that the protein content of SBN from numerous places in Indonesia (West Sumatera, South Sumatera, West Java, West Kalimantan, Central Sulawesi, and South East Sulawesi) ranged between 53.09-56.25% (average 54.58%), which was higher than that found in this study. Figure 1 shows a comparison of the protein composition in our research to numerous earlier studies.

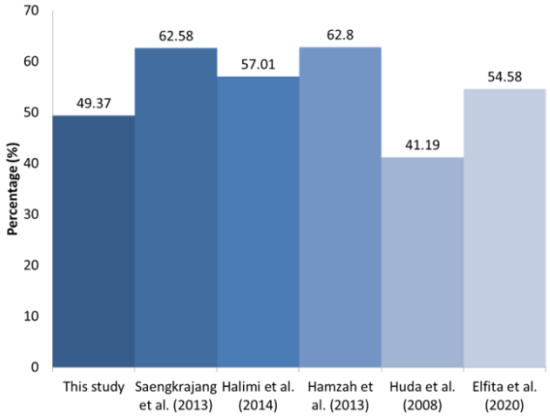


Figure 1. Comparison of protein content in this study with several previous studies

Protein is a prominent component of SBN, accounting for 50-65% of dry-weight SBN, and it plays a crucial role in nutritional and pharmacological effects, as well as having important biological roles (Ma and Liu, 2012). Factors that contribute to the high protein content include the environment and the amount of food in the swallow's home (Marcone, 2005) Protein stands as a crucial nutritional element for our body, functioning both as an energy source and as a foundational and regulatory element in bodily tissues. Protein serves as a reservoir of amino acids that encompass compounds of carbon, hydrogen, oxygen, and nitrogen, distinct from those found in fats and carbohydrates. The protein molecule additionally encompasses phosphorus, sulfur, and select minerals like iron and copper (Winarno, 2002). During the nesting process, the swallow's diet also greatly influences the protein content of the nest (Halimi *et al*., 2014).

Fat, the smallest constituent, was shown to differ considerably amongst SBN from various regions. The fat level ranged between 1.48 and 2.47% (average 1.92%), with SBN from BK and PD having the highest and lowest percentages, respectively (Table 1). The fat content in this research was higher than that of Malaysian SBN (Pahang and Terengganu), which ranged from 0.29 to 0.67%. (Halimi *et al*., 2014), Thailand, which was 0.4-1.3% (average: 0.96%) (Saengkrajang *et al*., 2013), and Malaysia (Penang), which varied from 0.47 to 2.00% (average 0.80%). (Huda *et al*., 2008), Malaysia (Perlis and Langkawi), and Indonesia (Java, Kalimantan, Balikpapan), which varied from 0.04% to 0.07% (average 0.052%). Hamzah *et al*., 2013. Elfita *et al*., (2020) found that the fat content of SBN from several regions in Indonesia (West Sumatera, South Sumatera, West Java, West Kalimantan, Central Sulawesi, and South East Sulawesi) ranges between 0.07-0.57% (average 0.33%), which was lower than that found in this study. Figure 2 compares the fat content in our research to that of various earlier studies.

Fat content in SBN is very low in the form of palmitate, stearate, linoleate, and linolenic acid. The content of mono- and diglycerides in SBN is very high, but their function and origin are still unclear. It is thought that this content is due to hydrolytic cleavage of triacylglycerols caused by moisture in the cave or as a result of the action of enzymes present in SBN (Marcone, 2005). Fats are an integral aspect of any food. Certain fats are acquired from animals and plants and are utilized in culinary preparations. Fats and oils hold significant significance in upholding human well-being. Moreover, they function as more effective reservoirs of fuel when juxtaposed with

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carbohydrates and proteins. Fats and oils are present in nearly all kinds of foods, though in varying contents (Winarno, 2002).

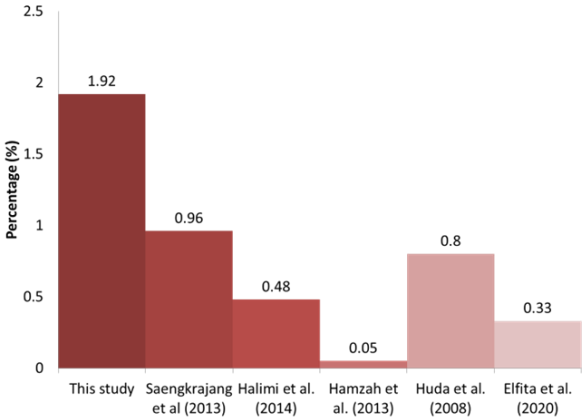


Figure 2. Comparison of fat content in this study with several previous studies

Moisture content ranged between 21.77 and 22.77% (average 22.38%), with the greatest and lowest nitrite concentration in SBN from BK and PD, respectively (Table 1). The moisture content was much greater than that of SBN from Malaysia (Perlis and Langkawi) and Indonesia (Java, Kalimantan, and Balikpapan), which were 10.87-13.88% (average 12.94%). Hamzah *et al*. (2013) SBN from Malaysia (Pahang and Terengganu) was 15.87-15.90% (average 15.89%). (Halimi *et al*., 2014), a little higher than those of SBN from Malaysia (Penang), which were 13.77-20.20% (average 16.15%) (Huda *et al*., 2008), but significantly lower than those of SBN collected from Thailand, which were 17.8-24.3% (average 19.82%) (Saengkrajang *et al*., 2013). Elfita *et al*., (2020) discovered that the fat content of SBN from numerous places in Indonesia (West Sumatera, South Sumatera, West Java, West Kalimantan, Central Sulawesi, and South East Sulawesi) ranged between 17.08-21.50% (average 18.64%), which was lower than that found in this study. Figure 3 compares the moisture content in our research to that of various earlier investigations.

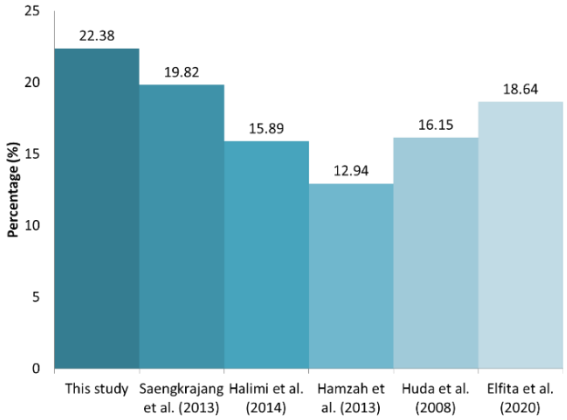


Figure 3. Comparison of moisture content in this study with several previous studies

Moisture content is commonly used as an indicator of the stability and quality of an edible bird's nest (Hamzah *et al*., 2013). Moisture content is the proportion of water in a particular material, usually stated as a percentage. It holds significant importance in food products, influencing their visual appeal, texture, and flavor. Additionally, water content is important in determining the freshness and shelf life of food items. Elevated water content facilitates the growth of bacteria, yeast, and mold, which can alter both the appearance and content of the food.

Conversely, reduced water content curbs the proliferation of microorganisms, consequently slowing down the deterioration process of the food product (Winarno, 2002).

Nitrite Content

Table 2. Nitrite content of swiftlet bird nest (SBN) from several regions in West Sumatera

SBN Sample	Nitrite Content (ppm)
PD	32.72
BK	24.75
PS	27.12

PD = Padang, BK = Bukittingi and PS = Pesisir Selatan

Based on Table 2, nitrite concentrations were from 24.75 to 32.72 ppm (average 28.19 ppm), with SBN from PD and BK having the greatest and lowest nitrite content, respectively. According to Hamzah *et al*. (2013), clean SBN collected in Kalimantan and Perlis was nitrite-free. They found nitrite in clean SBN from Java, Balikpapan, and Langkawi, however, the concentration was extremely low (0.3 ppm). Furthermore, Paydar *et al*. (2013) found that nitrite concentrations in Malaysian household SBN ranged from 7.9 to 22.0 ppm (average 14.3 ppm). Elfita *et al*. (2020) discovered that the fat content of SBN from numerous places in Indonesia (West Sumatera, South Sumatera, West Java, West Kalimantan, Central Sulawesi, and South East Sulawesi) ranged between 3.11-18.28 ppm (average 8.40 ppm), which was lower than that found in this study. Figure 4 shows a comparison of the nitrite concentration in this research to that of various earlier investigations.

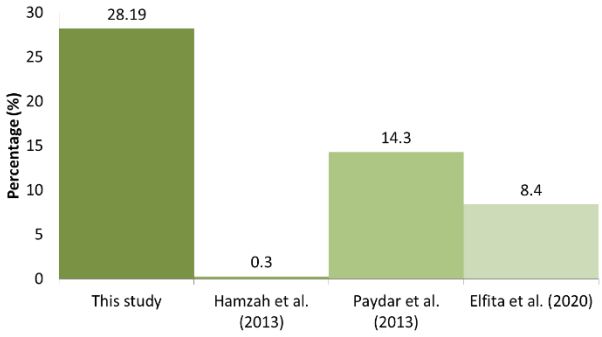


Figure 4. Comparison of nitrite content in this study with several previous studies

Swallow nests contain nitrite due to the decomposition of organic components found at the bottom of the nest house or cave (Hamzah *et al*., 2013). This decomposition is initiated by a large amount of swallow droppings and high humidity (80-90%). The decomposition of swallow droppings produces NO2 gas, which then settles into nitrite compounds in the bird's nest (Kuntjoro, 2016).

Potential as Functional Food

It is based on Table 1, the protein content in swiftlet bird nest (SBN) was from 47.65-50.55% (average 49.37%), which was greater than other protein sources such as meat (20-33%), fish (20-25%), eggs (14%), milk (3-28%), beans (5-8%), and cereals (3-12%) (British Nutrition Foundation, 2021). According to (Gur *et al*., 2018), functional food is a natural or manufactured food that has a high concentration of physiologically active substances like protein. The Swiftlet's bird nest (SBN) is an expensive and precious component (Babji *et al*., 2015). One of the

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important nutritional characteristics of SBN is its unique and abundant glycoprotein rich in sialic acid, which contains glycan, calcium, sodium, potassium, and a full amino acid profile (Babji *et al*., 2015; Noor *et al*., 2018). SBN's unique glycoprotein sets it apart from other protein sources like chicken and fish in terms of solubility, functionality, and bioactive compounds (Babji *et al*., 2015). This resulted in SBN as a better protein source acceptable for all persons.

Wong (2013) reported that SBN is regarded as medicine. Assisting in the treatment and recovery of certain disorders, such as asthma, thereby benefits human health. For example, as a medicine, the SBN glycoprotein contains epidermal growth factor (EGF), which contributes to a mitogenic response and cell growth (Hwang *et al*., 2020); sialic acid (N-acetylneuraminic acid), which enhances immunity by binding with influenza viruses, inhibits haemagglutination of influenza viruses (Chan *et al*., 2018); improves bone strength due to high calcium content, and more (Wong *et al*., 2018).

CONCLUSIONS

The study revealed that Swiftlet Bird's Nest in several regions in West Sumatra contains 47.65–50.55% (average 49.37%) protein, 1.48–2.47% (average 1.92%) fat, 21.77–22.77% (average 22.38%) water, and 24.75–32.72 ppm (average 28.19 ppm) nitrate. The nutrition and mineral content might be different based on the species, habitat location, seasonal variations, weather conditions, and other external factors. Protein content in Swiflet bird nests is higher than that of meat, fish, eggs, milk, beans, and grains. SBN is regarded as a medicine and can promote human health. Many benefits of SBN include promoting cell growth, enhancing immunity, and improving bone strength.

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