International Journal of Pharmacy and Applied Health Sciences
Volume 1, Issue 1, pp 1-5, June 2023

FTIR Spectroscopic Characterization of Edible Bird's Nest From Jenamas Central Kalimantan

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Received:
01 June 2023

Accepted:
15 June 2023

Published:
30 June 2023

ABSTRACT

Edible bird's nest is one of Indonesia's export commodities that has high economic value, because it is known for its health benefits. The main components of Edible bird's nest, namely water-soluble proteins, carbohydrates, fats, trace elements such as calcium, phosphorus, iron, sodium and potassium as well as amino acids play an important role in increasing body stamina. This study aims to identify the functional groups of Edible bird's nest using Fourier transform infrared spectroscopy. Samples prepared from Jenamas, central Kalimantan. The sample contains hydroxyl functional groups (alcohols), alkanes, alkynes, amides I, amides II, carboxylic acids, amines, primary alcohols, alkenes, halogen bromides, and halogen iodides. The results of this study found that the samples contained functional groups related to proteins (amino acids) and carbohydrates as indicated by the presence of the functional group -COOH (carboxylic acid) with an absorption value of 1396 cm^{-1} and N-H (amines) with an absorption value of 1111.25 cm^{-1}.

Keywords: Edible bird's nest, FTIR

INTRODUCTION

Edible bird's nest (EBN), which is produced from the condensed salivary secretions of certain swiftlet species during the breeding season, is one of the most valuable animal by-products in the world. The composition and medicinal properties of EBN have been studied extensively, but genomic and transcriptomic studies of the salivary glands of this bird have not been carried out. Transcriptomic analysis of the salivary glands of different swiftlet species revealed differential expression of candidate genes involved in salivary gland development and in the biosynthesis of various bioactive compounds found in EBN (Looi et al, 2017).

Edible bird's nest is not only widely consumed by Indonesian people as a nutritious food, but also believed to be used as medicine and one of the high export commodities (Lestari & Pratama, 2021; Sandi & Rahmatullah, 2017). From 20 types of amino acids, bird's nest contains 17 amino acids. There are 8 types of essential amino acids and 9 types of non-essential amino acids (Elfita, 2014). The amino acid content in swallow's nest is more complete than that of other foods, so swallow's nest is known as a complete food with amino acids. Therefore, swallow's nest is known as a food that is useful as a cure for various diseases because of its benefits in increasing the body's immunity, metabolism, and repairing damaged organ parts (Sirenden et al, 2018). EBN are mainly from the species of Collocalia and Aerodramus which can be found in South East Asian countries such as Indonesia, Malaysia, Philippines, Thailand, Vietnam and small part of southern China (Marcone, 2005).

In this study, the Fourier transform infrared spectroscopy (FTIR) system was utilized and its feasibility for identification of EBNs was verified. The EBN is taken from Jenamas, Central Kalimantan.

MATERIALS AND METHODS

Samples

The swallow nests tested came from Jenamas, Central Kalimantan. Edible bird's nest are cleaned of dirt and then dried at room temperature.

FTIR

The samples were subjected to ordinary FTIR spectrometry (Bruker) under a spectral scanning range of 4000 ~ 450 cm^{-1} for data collection and spectral processing.

RESULTS AND DISCUSSION

Results

Figure 1 showed EBN that has been cleaned of dirt.

Figure 1: Edible bird's nest

The KBr disc of EBN samples was analyzed to determine the purity of EBN using the Fourier transform infrared spectroscopy (FTIR) technique.

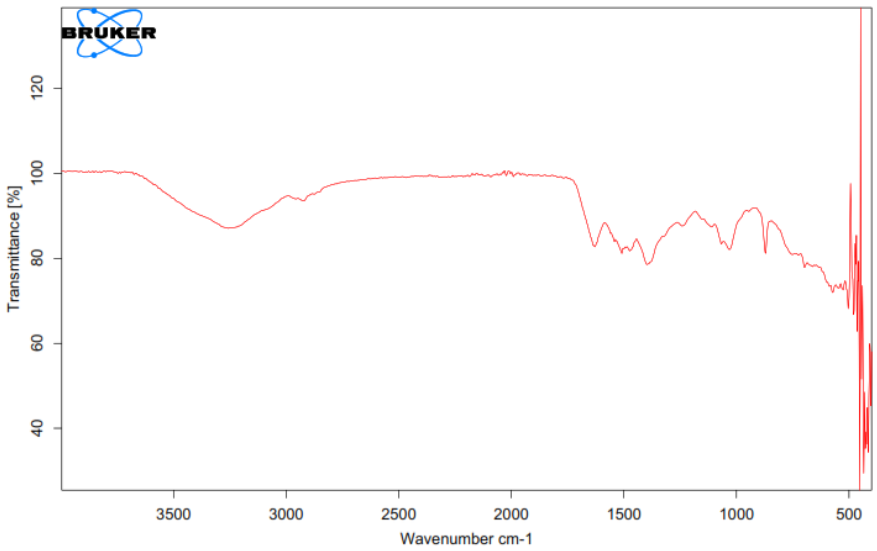

Figure 2: FTIR spectra of EBN samples

Figure 2 Shows the FTIR Spectroscopy spectrum of the Swallow's Nest (Aerodramus fuciphaga) wavelength setting 4000 ~ 450 cm^{-1}.

Table 1. Absorption range (cm^{-1}) and functional groups of EBN

No.	Absorption ranges (cm^{-1})	Functional groups	Compound class	Absorption sample (cm^{-1})
1	3550-3200	O-H stretch	Alcohol	3256,29
2	3000-2840	C-H stretch	Alkane	2921,89
3	2140-2100	C≡C stretch	Alkyne	2116,48
4	1695-1630	C=O stretch	Amide I	1635,28
5	1560-1500	N-H bend	Amide II	1508,86
6	1440-1395	O-H bend	Carboxylic acid	1396,71
7	1250-1020	C-N bend	Amine	1111,25
8	1085-1050	C-O stretch	Primary alcohol	1031,73
9	895-885	C=C bend	Alkene	870,65
10	690-515	C-Br stretch	Halogen bromide	572,96
11	600-500	C-I stretch	Halogen iodide	503,63

Discussion

Edible bird's nest currently have high economic value. Swiftlet's nest is also one of the products imported abroad. Edible bird's nest must have references or fingerprints of the compound's content and purity. Identification of the functional groups of the swallow's nest using FTIR spectroscopy can be one way to test its purity.

The working mechanism of the FTIR Spectroscopy instrument is based on the absorption spectra of various functional groups, which reflect the presence of chemical components based on wavelength and intensity. It is good at capturing whole images of chemical compounds, with the advantage of being sensitive, fast, and easy to use. Today, FTIR spectroscopy has become an attractive technology for the food industry as it achieves high analytical speeds and requires little or no sample preparation, especially ideal for large volumes and rapid screening of food components when combined with multivariate data analysis (Guo et al., 2018).

a. Spectrum region 3550-3200 cm^{-1}

The strain spectrum is in the region of 3550-3200 cm^{-1} for the -OH (alcohol/hydroxyl) functional group strain. The sample has a wavelength of 3256.29 cm^{-1}. This indicates the presence of water molecules in the sample. The water molecules contained in the sample probably came from the washing and humidity processes (Bhernama et al., 2020; Hamzah et al., 2013; Ibrahim, Nasir, et al., 2021).

b. Spectrum region 3000-2840 cm^{-1}

Spectral strain in the region of 3000-2840 cm^{-1} for the C-H (alkane) functional group strain which indicates the presence of lipid content (Guo et al., 2018; Ibrahim, Nasir, et al., 2021). The sample has a wavelength of 2921.89 cm^{-1}.

c. Spectrum region 2140-2100 cm^{-1}

Spectral strain in the region of 2140-2100 cm^{-1} for the functional group strain C≡H (alkynes) (Ibrahim, Nasir, et al., 2021). The sample is at a wavelength of 2116.48 cm^{-1}.

d. Spectrum region 1695-1630 cm^{-1}

Spectral strain in the region of 1695-1630 cm^{-1} for the C=O (Amide I) functional group strain (Ibrahim, Nasir, et al., 2021). The sample is at a wavelength of 1635.28 cm^{-1}.

e. Spectrum region 1560-1500 cm^{-1}

The spectrum curve is in the region of 1560-1500 cm^{-1} for the N-H (Amide II) functional group bend. This spectral curve indicates the presence of protein (Hamzah et al., 2013; Ibrahim, Nasir, et al., 2021). In the indentation sample at a wave view of 1508.86 cm^{-1}.

f. Spectrum region 1440-1395 cm^{-1}

The spectral curve is in the region of 1440-1395 cm^{-1} for the O-H (carboxylic acid) functional group bend. The functional group of this carboxylic acid is thought to be the structural structure of an amino acid compound (Ibrahim, Nasir, et al., 2021). In the indentation sample at a wavelength of 1396.71 cm^{-1}.

g. Spectrum region 1250-1020 cm^{-1}

Spectrum strain in the region of 1250-1020 cm^{-1} for the C-N (Amine) functional group strain. The functional group of this carboxylic acid is thought to be the structural structure of an amino acid compound (Ibrahim, Nasir, et al., 2021). In the strain sample at a wavelength of 1111.25 cm^{-1}.

h. Spectrum region 1085-1050 cm^{-1}

Spectral strain in the region of 1085-1050 cm^{-1} for the C-O (primary alcohol) functional group strain. This functional group indicates the presence of carbohydrates (Ibrahim, Nasir, et al., 2021). In the strained sample at a wavelength of 1031.73 cm^{-1} which indicates the presence of polysaccharides.

i. Spectrum region 895-885 cm^{-1}

The spectrum curves in the region of 895-885 cm^{-1} for the C=C (alkene) functional group strain. In the indentation sample at a wavelength of 870.65 cm^{-1}. In another study, the wavelengths of the alkene functional groups were at absorptions of 895.29 cm^{-1} and 886.06 cm^{-1}. This structure is part of the structure of amino acids, proteins, and carbohydrates that contain alkene structures.

j. Spectrum region 690-515 cm^{-1}

The strain spectrum in the region of 690-515 cm^{-1} for the C-Br (halogen bromide) functional group strain. In the strain sample at a wavelength of 572.96 cm^{-1}.

k. Spectrum region 600-500 cm^{-1}

Spectral strain in the region of 600-500 cm^{-1} for the C-I (halogen iodide) functional group strain. In the strain sample at a wavelength of 503 cm^{-1}.

CONCLUSION

The sample contains hydroxyl functional groups (alcohols), alkanes, alkynes, amides I, amides II, carboxylic acids, amines, primary alcohols, alkenes, halogen bromides, and halogen iodides. The results of this study found that the samples contained functional groups related to proteins (amino acids) and carbohydrates as indicated by the presence of the functional group -COOH (carboxylic acid) with an absorption value of 1396 cm^{-1} and N-H (amines) with an absorption value of 1111.25 cm^{-1}.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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