

## **Analysis of Cellulose and Nitrogen Content of Nest Materials of a Higher Termite *Globitermes sulphureus* (Haviland)**

by

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### **Abstract**

We investigated the cellulose and nitrogen content of nest materials of a higher termite, *Globitermes sulphureus* (Haviland) by focusing on the inner and exterior parts of the mound and the adjacent soil material. Nest materials were collected from several locations in Penang, Malaysia. Results indicated that the inner part (2<sup>nd</sup> layer) of the termite nest was richer in nutrition properties (cellulose and nitrogen) than the outer part (3<sup>rd</sup> layer) of nest and the adjacent soil, indicating that it was used for food storage. There was no significant difference ( $P > 0.05$ ) in nitrogen and cellulose content between the nests materials collected from different locations.

**Key words:** *Globitermes sulphureus*, nest carton, nutrition properties, food store

### **Introduction**

*Globitermes sulphureus* (Haviland), classified under family Termitidae, is commonly found in Malaysia, Singapore and Vietnam. This species can be easily identified based on the bright yellow colored abdomen of the soldiers (Lee et al, 2003). *G. sulphureus* is highly prevalent in Malaysia and forage on dead wood, and sometimes also attack living trees and buildings (Krishna and Weesner, 1970). Haris (1971) reported that *G. sulphureus* is one of the important termite pests in agriculture plantation such as coconut and oil palm plantations.

*G. sulphureus* can also be found in- and around buildings and structures in Malaysia. Lee (2007) reported that the paper-based bait is not effective against this species, possibly due to the lack of palatability as well as other biological factor. However, more recently Neoh et al. (in press) has successfully eliminated *G. sulphureus* colonies using bistrifluron baits. However, the baiting duration reported was remarkably longer than against the lower termite species. It was believed that the process of food-handling by this species may have delayed and reduced the delivery of the toxicant among colony members. In this study, the cellulose and nitrogen content of nest materials of a higher termite, *Globitermes sulphureus* (Haviland) by focusing on the inner and exterior parts of the mound and adjacent soil material.

### **Materials and methods**

#### Sampling

Sampling of *G. sulphureus* nest materials was done at 3 locations in Penang namely in the grassy land, and in the city. Total of 2 – 5 mounds were chosen from each location. The height and width of the base of the mound were measured and recorded. The dimensions of the mounds are presented in Table 1. Samples were taken at two sections of the mound; inside and outside the

mound. The inner material was taken from the 2<sup>nd</sup> layer of the nest and its dark brown in colour, and located near to the royal chamber. The exterior section was taken from the 3<sup>rd</sup> layer of the nest characterized by its dark color and high level of hardness. The adjacent soils were taken at 10 – 20 cm away from each mound. Three sections of circumferences of the mound were taken from 5 – 15 cm depth.

Table 1. Mounds dimension at varies site.

No	Sampling Location / site		Height (mm)	Width (mm)
1	City	1 <sup>st</sup> mound	40	38
		2 <sup>nd</sup> mound	55	51
		3 <sup>rd</sup> mound	64	54
		4 <sup>th</sup> mound	41	43
		5 <sup>th</sup> mound	49	58
2	Forest	1 <sup>st</sup> mound	43	37
		2 <sup>nd</sup> mound	68	42
3	Grass	1 <sup>st</sup> mound	54	46
		2 <sup>nd</sup> mound	51	48
		3 <sup>rd</sup> mound	57	52

#### Laboratory analysis

Cellulose content analysis was carried out following method by Daji, (1932) and modification of Jenkins and Charpentire’s methods. Around 10 gram of soil sample was treated with hot diluted alkaline and acid and, then with the solution of sodium hypochlorite in the cold. Cellulose was then extracted from the residue with Schweitzer’s reagent, precipitated with alcohol and determination by loss of weight on ignition. Kjeldahl method was applied for nitrogen determination following method of Wilde, *et al.* (1972). The total of organic nitrogen, ammonia and ammonium in the termite nest materials were determined. Sample was boiled in concentrated sulfuric acid, resulting an ammonium sulfate solution. This was directly titrated and boric acid was used as the receiving solution instead of a standardized mineral acid. The boric acid will capture the ammonia gas, forming an ammonium-borate complex and it will change the color of solution.

#### Statistical analyses

Statistical analyses were done by using PASW Statistic 18 computer software. Differences were tested by analyzing the variations, and by carrying out subsequent post hoc comparisons (Tukey HSD). All tests were performed at P = 0.05.

### **Results and discussions**

Table 2 shows the comparison of cellulose contents between inner, outer part and adjacent soil from all areas. There were no significant differences between the cellulose contents in nest materials collected from different localities. The inner nest material has a higher content of cellulose compared to that of the outer and adjacent soil indicating that the inner part of *G. sulphureus* is likely used as food storage. This indicates that after *G. sulphureus* forages for food, some food will be digested and transferred to other colony members, while others are stored at the center of their nest. Chemical analysis of *G. sulphureus* (Haviland) carton revealed that the inner part of the nest

was made from undigested food (Noirot, 1959). In addition, Barbara et al. (1996) also found that the inner part of *Nasutitermes* sp. mound had higher cellulose content when compared to normal nest carton.

Table 2. Cellulose content of nest materials of *G. sulphureus* termite carton from three localities.

No	Sample site	Cellulose content (%) <sup>1</sup>		
		City	Forest	Grass
1	Inner	59.78 ± 2.01a	56.22 ± 1.39a	57.93 ± 2.19a
2	Outer	14.18 ± 2.22a	18.47 ± 1.58a	25.23 ± 4.30b
3	Adjacent	27.12 ± 4.69a	35.77 ± 5.80a	19.70 ± 1.65a

<sup>1</sup>Means followed by the same letter within the same row are not significantly different (P>0.05; Tukey HSD)

The content of cellulose in adjacent soil was highest in the forest area when compared to other places (city and grassy land). It is likely that the cellulose concentration in soil is derived from the degradation of the twigs, wood and leaf litters. Table 3 shows nitrogen content of inner, outer and adjacent soil of termite mounds. The content of nitrogen inside the mound was higher compared to outer and adjacent soil.

Table 3. Nitrogen content of termite nest materials from three localities.

No	Sample site	Nitrogen content (%) <sup>1</sup>		
		City	Forest	Grass
1	Inner	873.45 ± 453.47a	423 ± 140.44a	475.56 ± 216.48a
2	Outer	218.60 ± 61.49a	193.25 ± 22.69a	310.68 ± 94.62a
3	Adjacent	118.76 ± 26.07a	82.63 ± 38.25a	134.21 ± 63.43a

<sup>1</sup>Means followed by the same letter within the same row are not significantly different (P>0.05; Tukey HSD)

The amount of nitrogen (N) and organic matter (data was not showed) in the inner and outer part of mound was significantly higher when compared to that of adjacent soil. The content of nitrogen and total carbon possibly came from the materials that termite used for their nest. As reported by Brauman (2000), the amounts of nitrogen and organic carbon were derived from small fraction of dead wood, leaves, twigs combined with saliva and soil and used as material for the nest construction. Termite not only digested, decomposed and mixed the lignocelluloses material but they also swallowed nutrients contained in soil (Bauman, 2000). Decomposition process of dead wood, leaves and twigs into smallest particles will increase fungi and bacteria activity, thus helping in creating the humic substance (Brauman, 2000). The organic material which passes through the digestive tract is subjected to various chemical and biological processes that may alter the amount of organic matter, as well as humification degree and complexation with metal ions (Brauman, 2000). Thus, the higher degree of carbon and nitrogen in termite nests comparison with adjacent soil were attributed to termite behavior of ingesting soil organic matter and returning it as fecal or bucal pellets, in which organic matter was physically and chemically protected, forming stable aggregates. The mound locations of *G. sulphureus* did not influence the cellulose and nitrogen contents. The inner part of the mound contains high cellulose and nitrogen compared to outer part and also adjacent soil.

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