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RICH MICROBIAL COMMUNITY ASSOCIATED WITH THE NEST MATERIAL OF RETICULITERMES FLAVIPES (ISOPTERA: RHINOTERMITIDAE)

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Subterranean termites live in a soil environment that can contain a rich community of microorganisms and the nest material can be a site of enhanced microbial activity (Holt & Lepage 2000). By using feces and saliva as building materials for nest construction and gallery systems, termites can alter the qualitative and quantitative composition of the resident soil microorganism community from adjacent soils (Jouquet et al. 2005). Keya et al. (1982) suggested that a significant part of the altered microorganism community was mostly composed of cellulose decomposers, but function and origin of the microbial community associated with termite nests remains unclear. In this report we evaluate whether subterranean termites have the ability to import various microorganisms from distant soils or from their own gut microbial community into a microorganism-free soil environment.

In Chouvenc et al. (2008), we investigated the survivorship of groups of 960 Reticulitermes flavipes (Kollar) from large two-dimensional arenas filled with sterile sand (washed with 70% ethanol, rinsed with sterile deionized water and oven dried at 60°C for 24 h). At the end of the 90-d experiment, 4 arenas from 2 different termite colonies were dismantled to obtain 2 types of nest material: (1) gallery material including sand mixed with termite fecal material from termite galleries, and (2) non-gallery material including undisturbed sand (not tunneled by the termite) at least 3 cm away from any termite gallery (Fig. 1). A total of 12 soil samples per arena (10 g per sample) including 6 samples for each type of nest material were collected. In order to estimate the microbial communities in the 2 types of nest material, 1 g sub-sample from each original sample was processed following the general procedure described in Elliott & Des Jardin (1998). Serial dilutions of the sub-samples were made (10⁻¹ to 10⁻⁷) with sterile water and the diluted sub-samples were plated on 5 different selective media to isolate various groups of microbes including (1) overall aerobic bacteria, (2) fluorescent pseudomonads, (3) actinobacteria, (4) overall fungi and, (5) entomopathogenic fungi. All selective media were previously described in Elliott & Des Jardin (1998) except the medium for entomopathogenic fungi (Veen & Ferron 1966). Soil samples collected from a control arena were established with only sand and no termites to confirm the absence of microbes in the sterile sand. Growth of microbes for each dilution and each selective medium was quantified to estimate the overall microbial structure of the 2 nest materials (Table 1). Individual microbe colonies were selected and transferred on 1/5 strength potato dextrose agar. Based on colony morphology of more than 2,000 isolates, we found 432 morphologically distinct isolates including 399 aerobic bacterial isolates, 11 actinobacterial isolates, and 22 fungal isolates. The molecular identification of these isolates and their potential function will be presented elsewhere.

Fig. 1. A group of termites in a two-dimensional arena for 90 d. Arrows show sampling sites for microbial isolation. Note the dark shade in the gallery wall showing the presence of deposited fecal material. Bar = 1 cm.
TABLE 1. COLONY FORMING UNITS (CFUS) OF VARIOUS MICROBE GROUPS GROWN ON DIFFERENT SELECTIVE MEDIA, PER GRAM OF SAMPLE OF TERMITE-GALLERY MATERIAL AND NON-GALLERY MATERIAL (MEAN ± SE).

<table>
<thead>
<tr>
<th>Microbe Group</th>
<th>Gallery material</th>
<th>Non-gallery material</th>
<th>t-test(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall aerobic bacteria</td>
<td>3.5 × 10^7 ± 7.9 × 10^6</td>
<td>3.9 × 10^7 ± 5.2 × 10^6</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Fluorescent Pseudomonads</td>
<td>7.2 × 10^7 ± 3.0 × 10^6</td>
<td>8 ± 6</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Actinobacteria</td>
<td>1.4 × 10^7 ± 2.8 × 10^6</td>
<td>1.1 × 10^7 ± 5.2 × 10^6</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Overall fungi</td>
<td>6.1 × 10^7 ± 1.1 × 10^6</td>
<td>4.3 × 10^7 ± 1.6 × 10^6</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Entomopathogenic fungi</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>N/A</td>
</tr>
</tbody>
</table>

\(^a\)Total number of samples plated on a given selective media per concentration from serial dilutions.

\(^b\)For a given microbe group based on selective media, comparison of the colony forming units between gallery material and non-gallery material.

Field-collected subterranean termites were held in groups of 960 individuals for 90 d in two-dimensional arenas filled with sterile sand. After 90 d, the tunnel walls made of sand mixed with fecal material, and sand from areas not disturbed by termites were compared for the presence of microbes. We show that a rich microbial community associated with the termites can colonize the termite nest environment and is primarily associated with the tunnels.

REFERENCES CITED

CHOUVENC, T., AND SU, N.-Y. 2010. Apparent synergy among defense mechanisms in subterranean termites (Rhinotermitidae) against epizootic events - The limits and potential for biological control. J. Econ. Entomol. 103: 1327-1337.


SUMMARY

Field-collected subterranean termites were held in groups of 960 individuals for 90 d in two-dimensional arenas filled with sterile sand. After