

# Phytochemistry and anti-microbial evaluation of *Thaumatococcus danielli*, Benn. (Benth.) leaves

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## ABSTRACT

Leaves of *T. danielli* are mostly used as food wrappers, and for thatching roofs in the rural and sub-urban areas of south-western Nigeria. Phytochemistry of the leaf extracts revealed the presence of alkaloids, tannins, saponins, anthraquinones, cardenolides and steroidal nucleus compounds. Thin layer chromatography of the leaf extracts confirmed the presence of these secondary metabolites. Antimicrobial screening of the leaf extract against selected microbes associated with food spoilage revealed a lack of activity against these microbes; viz; *Salmonella*

*typhimurium*, *Shigella dysenteriae*, *Shigella sp*, *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus lactis*, *Leuconostoc sp*, *Pediococcus cerevisae*, *Bacillus cereus*, *Candida krusei*, *candida albicans*, *Aspergillus niger*, *Aspergillus flavus* and *Trichoderma konigii*. Aromatic (sweet smelling) oil was extracted from the leaves of the plant, which likely accounts for the enhanced flavour associated with foods wrapped with these leaves.

**Key words:** *Thaumatococcus danielli*, phytochemistry, antimicrobial evaluation, aromatic oil.

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## INTRODUCTION

Food wrappers (packaging) are meant to preserve, extend shelf life, retain nutrients, and present food for consumption to the end user, amongst other uses. Thus, there are a lot of technologies/ techniques used in packaging/wrapping foods. This varies with geographical location, tradition/culture, level of industrialization, urbanization, economic status, desired effect of manufacturer, and of course, preference of the end user.

The informal/indigenous fast food industries in Nigeria are quite established, and try hard to meet

the dietary needs of the teeming populace in every geographical part of the country. Depending on location and locality, various types of plant leaves are used as wrappers, e.g., banana/plantain leaf, i.e. *Musa sapientium*, *Musa paradisiaca*, *Cola nitida* and *Thaumatococcus danielli* leaves (Adegunloye *et al*, 2006), to package and present foods to clientele. The use of these leaves, are very ancient ways (traditions) of the peoples, the basis of which cannot be easily ascertained, but a cursory look at these leaves, reveal that they all have large surface areas, i.e. can, and are used to hold/package/wrap large volumes of food.

The sweetener plant *Thaumatococcus danielli* Benn (Benth.) is a member of the Maranthaceae family. It has long slender stalks, reaching heights of about 2-3 meters. The stalk terminates into a single tough, almost round and versatile leaf of varying sizes depending on the age and habitat of the plant. (Makinde and Taiwo, 2004) It is a multi purpose perennial herb that offers a wide range of uses with its leaves, fruits, stalks and rhizomes. It has been domesticated in most parts of South Western Nigeria, where it contributes to the economy of the rural population (Arowosoge and Popoola, 2006, Osemeobo, 2005).

The plant is of global prominence, consequent upon the discovery of “*thaumatin*”, a non-caloric sweetener derived from the arils of the plant which is reportedly 1600 times sweeter than sucrose (Zemanek and Wasserman, 1995). Much work has been carried out on various aspects of the sweetener containing arils of this plant. (Elemo *et al*, 1999, Zemanek and Wasserman, 1995). All parts of the plant are useful, with the stalk used for weaving mats, the arils used to sweeten foods locally and in the production of thaumatin (Elemo *et al*, 1999), while the leaves are used for thatching roofs and in wrapping foods. The leaves are popularly used as a wrapping material for different categories of food, viz; unprocessed e.g. meat, kola nuts; semi-processed, e.g. fermented locust beans, and processed (cooked) foods like cooked rice, beans, maize meal, pounded yam etc.

The use of leaves as a food wrapper/ presentation material is no more restricted to the local populace resident in the villages and suburbs, it has gained widespread acceptance not only in the towns and cities of South Western Nigeria, but also in some parts of the United States and the South Americas, where it is now acceptable and hip to display, buy, and eat foods packaged in such, even among the elites who consider the packaging (wrapping), as not only exotic, but also flavour enhancing. (Thorn, 2004) There are about 250,000 - 500,000 species

of plants in existence, but only very few of these have been screened for their antimicrobial potentials (De Lucca *et al*, 2005)

This study was pre-empted by the sudden unprecedented rise in the acceptability of these leaves as a wrapping/packaging in the indigenous fast food and food processing industries. An attempt would be made to verify the health/scientific benefits (if any), inherent in the wrapping/packaging and presentation of different types of food at their various stages of processing using the *Thaumatococcus danielli* leaves via phytochemistry and antimicrobial screening of the leaf extracts against a selection of microbes implicated in food spoilage.

## MATERIALS AND METHODS

### Sample collection / physical examination

The leaves of *T.danielli* were collected from Ogotun-Ekiti in Ekiti State (South West, Nigeria) and authenticated at the Botany Department of Lagos State University.

### Sample extraction

The leaves were washed clean and air dried. Dried leaves were macerated, and the resulting macerates used for the extraction processes viz;

- (a) Soxhlet extraction
  - (b) Steeping
  - (c) Hydrodistillation
- (Moronkola *et al*, 2003.)

### Microbes

The pathogens used in this study i.e., *Salmonella typhimurium*, *Shigella dysenteriae*, *Shigella sp*, *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus lactis*, *Leuconostoc sp*, *Pediococcus cerevisiae*, *Bacillus cereus*, *Candida krusei*, *candida albicans*, *Aspergillus niger*, *Aspergillus flavus* and *Trichoderma konigii* were obtained from the Nigerian Institute of Medical Research, Yaba, Lagos, Nigeria.

### **Antimicrobial screening.**

The methods used were (a) Agar diffusion well method of Bauer (1966), and Agar diffusion disc method by Cichewa *et al*, (1996).

### **Phytochemistry**

Standard Phytochemistry techniques (Odebiyi and Sofowora, 1978, 1979, Harbourne, 1973, Persinos and Quimby, 1976, Shopee, 1964, Trease and Evans, 1986,) were employed.

### **Thin Layer Chromatography**

All crude extracts were chromatographed on commercially prepared silica gel plates (G254) with the appropriate mobile phases after proper sample preparation (Simon, 1976.)

## **RESULTS AND DISCUSSION**

This study of *Thaumatococcus danielli* leaves, via phytochemistry and antimicrobial evaluation, is an attempt to unravel the scientific benefits (if any) derivable from packaging foods with leaves, such as this. The findings revealed that the four extracts i.e. chloroform, methanol, ethanol and aqueous (soxhlet and steeped), of *T. danielli* leaves had no significant antimicrobial activity against the proliferation of microbes used in this study, viz *Salmonella typhimurium*, *Shigella dysenteriae*, *Shigella sp*, *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus lactis*, *Leuconostoc sp*, *Pediococcus cerevisae*, *Bacillus cereus*, *Candida krusei*, *Candida albicans*, *Aspergillus niger*, *Aspergillus flavus* and *Trichoderma konigii*. (Tables 2 and 3). The microbes used in this study were selected on the basis of their implication as agents of food spoilage and food –borne diseases. (Hughey and Johnson, 1987)

This lack of antimicrobial activity is corroborated by the work of Adegunloye *et al* (2006), which examined the effect of handling on microbial load(count) of foods wrapped (packed) in leaves, and concluded that improper handling of leaves used as wrappers could be a source of introducing microbes into the foods eventually

packed in such leaves. Plants are known to produce secondary metabolites that complement their structural barrier in their efforts at warding off microbial attack. (De Lucca *et al*, 2005). Some of these secondary metabolites are present in the leaves of *T danielli* (Table 1) viz, alkaloid, tannins, saponins, anthraquinones, cardenolides and steroidal nucleus compounds. A number of the secondary metabolites are associated with different potentials in various plants,(Ojekale *et al*, 2006, Smith *et al*, 2001, Cowan 1999, Huynh *et al*, 1996), including antibacterial properties (Duraipandiyan *et al*, 2006), even though most of these have been conducted at the *in-vitro* level. (Cowan, 1999), although their functions in the leaves of *T. danielli* were not investigated in this study.

The essential oil extracted from the leaves is likely to be the flavour enhancer to foods packed in the leaves of *T. danielli*, as people who consume foods wrapped with these leaves affirm that, there is a particular flavour associated only with items wrapped with these leaves, as imparted by the oil, this is tangentially corroborated by the result of the study funded by the Department of Agriculture of the Government of Sri Lanka into the use of banana leaves as an environmentally friendly alternative food wrapper.(<http://www.agridept.gov.lk/>)

There is need for comprehensive analysis of the components of this oil and possibly propose uses for it, once its composition, tolerance, toxicity, etc are known, since a lot of oil bearing plants are known to have medicinal potentials, including antimicrobial potentials (Du Pork, 2006, Moronkola *et al*, 2003, Pandey *et al*, 2002,.) while some others serve as starting materials for the production of body care products like lotions, soaps, etc. (Kasali *et al*, 2002).

This study has been able to confirm a lack of antimicrobial activity against selected microbes and ascertain the presence of secondary metabolites in *Thaumatococcus danielli* leaves, functions to which cannot be ascribed in this study.

Table 1: Phytochemistry of *Thaumatococcus danielli* leaves

| Phytoconstituent      | Observation                                |
|-----------------------|--|
| Alkaloids             | Present                                    |
| Flavonoids            | Present                                    |
| Tannins               | Present                                    |
| Saponins              | Present                                    |
| Anthraquinones        | Present                                    |
| Anthocyanoside        | Absent                                     |
| Cyanogenic glycosides | Absent                                     |
| Cardiac glycosides    | Cardenolides and steroidal nucleus present |

**Table 2:** Antimicrobial screening of *T. danielli* leaves using soxhlet extraction

| <b>Organism</b>               | <b>Chloroform Extract</b> | <b>Methanol extract</b> | <b>Ethanollic extract</b> | <b>Aqueous extract</b> |
|-------------------------------|---------------------------|-------------------------|---------------------------|------------------------|
| <i>Salmonella typhimurium</i> | +                         | -                       | -                         | -                      |
| <i>Shigella dysenteriae</i>   | +                         | -                       | -                         | -                      |
| <i>Shigella sp</i>            | -                         | -                       | -                         | -                      |
| <i>Escherichia coli</i>       | -                         | -                       | -                         | -                      |
| <i>Staphylococcus aureus</i>  | -                         | -                       | -                         | -                      |
| <i>Streptococcus lactis</i>   | +                         | -                       | -                         | -                      |
| <i>Leuconostoc spp</i>        | -                         | -                       | -                         | -                      |
| <i>Pediococcus cerevisiae</i> | +                         | -                       | -                         | -                      |
| <i>Bacillus cereus</i>        | +                         | -                       | -                         | -                      |
| <i>Candidi krusei</i>         | -                         | -                       | -                         | -                      |
| <i>Candida albicans</i>       | -                         | -                       | -                         | -                      |
| <i>Candida valida</i>         | -                         | -                       | -                         | -                      |
| <i>Aspergillus niger</i>      | -                         | -                       | -                         | -                      |
| <i>Aspergillus flavus</i>     | -                         | -                       | -                         | -                      |
| <i>Trichoderma konigii</i>    | -                         | -                       | -                         | -                      |

**Key:**No antimicrobial activity.

**Table 3:** Antimicrobial screening of *T. danielli* leaves using steeped extracts

| Organism                      | Aqueous Extract | Ethanollic extract | Methanolic extract |
|-------------------------------|-----------------|--------------------|--------------------|
| <i>Salmonella typhimurium</i> | -               | +                  | +                  |
| <i>Shigella dysenteriae</i>   | -               | -                  | -                  |
| <i>Shigella sp</i>            | -               | -                  | -                  |
| <i>Escherichia coli</i>       | -               | +*                 | +*                 |
| <i>Staphylococcus aureus</i>  | -               | +                  | +                  |
| <i>Streptococcus lactis</i>   | -               | +                  | +                  |
| <i>Leuconostoc spp</i>        | -               | -                  | -                  |
| <i>Pediococcus cerevisiae</i> | +               | +                  | +                  |
| <i>Bacillus cereus</i>        | +               | +                  | +                  |
| <i>Candidi krusei</i>         | -               | -                  | -                  |
| <i>Candida albicans-</i>      | -               | +                  | +                  |
| <i>Candida valida</i>         | -               | -                  | -                  |
| <i>Aspergillus niger</i>      | -               | -                  | -                  |
| <i>Aspergillus flavus</i>     | -               | +                  | +                  |
| <i>Trichoderma konigii</i>    | -               | -                  | -                  |

**Key:** No antimicrobial activity, + slight antimicrobial activity, +\* slight/indistinct (fuzzy) antimicrobial activity

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