Sensitivity of *Porites compressa* corals to native Hawaiian plant *Scaevola taccada* extract

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Introduction

Oxybenzone (*2-Hydroxy-4-Methoxybenzophenone*) is an organic UV filter found in commercial sunscreens used to protect us from cellular damages caused by UV radiations [4]. This molecule is a growing source of aquatic pollution that interferes with coral larvae settlement, growth and coral recruitment [5, 6, 7]. *Scaevola taccada,* or Naupaka Kahakai (Fig. 1), is a coastal shrub, indigenous to the Hawaiian Islands [1]. Indigenous knowledge suggest that the fruit of *S. taccada* have UV absorbing properties that may represent a local alternative to commercial sunscreen chemicals. This study aims to assess the toxicity of *S. taccada* fruit extract in hopes to make a locally sourced reef-safe sunscreen.

Fig. 1: (A) *Scaevola taccada* (Naupaka Kahakai) on the KCC campus, Honolulu, HI. **(B)** Different stages of maturation of the fruits (*Top to Bottom:* Ripe, Semi-Ripe, Unripe Fruit).

Methods

Naupaka juice was extracted from the fruits through a sterile muslin cloth and purified by centrifugation and tested for its absorbance in UV, its stability when frozen, heated or left over time, and its toxicity to coral. Soft agar gels (2%) were placed on the coral to test toxicity. Negative control consisted of filtered sea water, positive control consisted of a toxin (from *Montipora capitata* eggs). Fresh and concentrated *S. taccada* extract was added to the gel. Gels were strapped onto coral fragments for four (4) days. [8]

Results

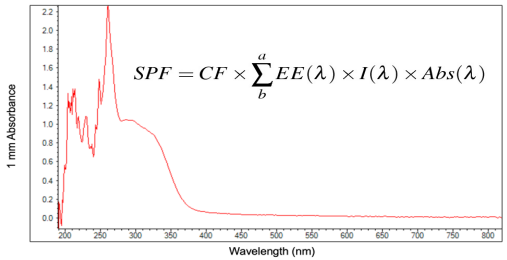


Fig. 2: *Spectrophotometry*: Absorbance assessment of the extract in UV range (200 nm to 400 nm) for each treatments The absorption spectrum shows a very strong absorption UV range (100 nm to 400 nm) and drops as we reach the visible light (400 nm to 800 nm).

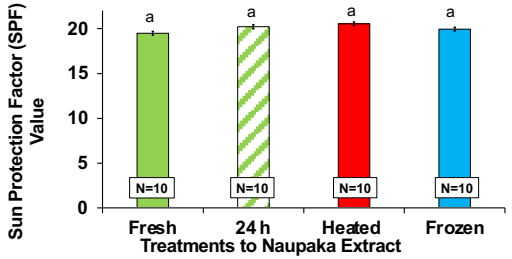
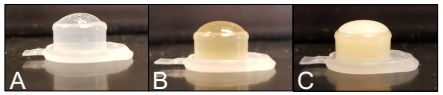


Fig. 3: Stability of the Sun Protection Factor (SPF) of Naupaka Extract to Different Treatments. Naupaka extract demonstrated stability over time, to heat (60°C for 1 h) and to frozen storage (–20°C) with a consistent calculated SPF value [2,3] of 20 (p> 0.05, F=1.018)



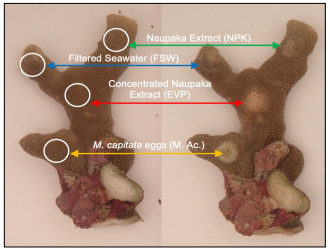


Fig. 4: Toxicity: Coral fragments pre- and post-treatment after gel treatments were strapped on to the coral for 4 days. Gels Treatments (above): **(A)** Filtered seawater (positive control) **(B)** Fresh *S. taccada* extract **(C)** Toxic eggs from *Montipora capitata* (negative control)

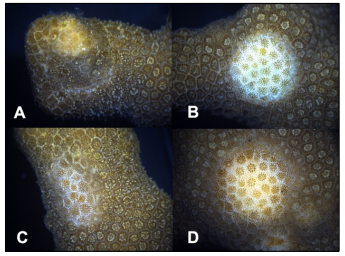


Fig. 5: Microscopic view of coral fragments post-treatment

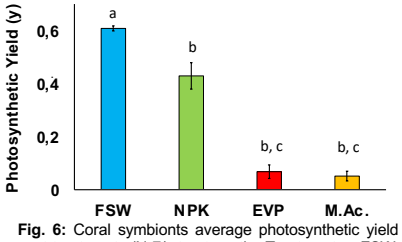


Fig. 6: Coral symbionts average photosynthetic yield post-treatment (N-7/ treatment). Treatments: FSW, filtered seawater, NPK, Naupaka extract, EVP, heated, concentrated naupaka extract, M. Ac. toxin.

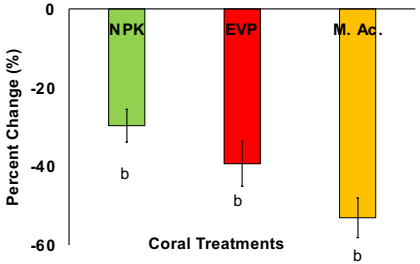


Fig.7: Average Coloration Percent Change Post-Treatment (n=7/treatment). Treatments: NPK, Naupaka extract, EVP, heated, concentrated Naupaka extract, Mac, toxin

Toxicity of *S. taccada* on Coral

Macroscopically, all treatments left an imprint on the *P, compressa* coral fragments (Figs. 4 & 5). However, the toxin left the most prominent mark with a 53.06% color change. Concentrated extract caused a 39.34% color change on the coral fragment. Fresh extract made a 29.67% color change. All treatments are different than the FSW control, but none of the treatments are different from each other (p<0.001, F=3.706) (Figs. 6 & 7). There was a decrease in photosynthetic activity from the symbionts from of 0.608 for filtered seawater to 0.429 for fresh extract and finally to a ten-fold decrease of 0.068 for concentrated extracts and 0.051 for for the toxin, respectively. All the treatments are different from the filtered seawater (p<0.001, F=84.5).. Concentrated Naupaka extract and the toxin were the same (p<0.001) (Fig. 6).

Discussion

- The absorption spectrum from spectrophotometer indicated that the Naupaka (*S. taccada*) extract contained UV absorbing properties with an SPF of 20 that can possibly be exploited.
- The SPF of the extract was stable to time, to heat and to frozen storage.
- *S. taccada* extracts in contact with the coral caused damage which was concentration dependent. The most concentrated demonstrated similar characteristics to those of the coral toxin: a decrease in photosynthetic activity and changes in coloration.
- The concentration of the extract plays a role in its toxicity. Due to the ocean's large volume, the toxic compounds will be diluted and hypothetically will not represent a threat to coral reefs. Ongoing research is being preform to confirm or deny that hypothesis.
- Experimental methods are being reviewed to obtain more accurate results.
- **Ongoing Research**: Preliminary data suggest that *S. taccada* extracts can potentially protect cells in culture by absorbing UV.

References

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