Analyzing the Nutritional Value of *Araceae* Food Crops in Palau

Amy-Lee Rhine
Republic of Palau

Mentors:
Christopher Kitalong, PhD, Palau Community College-Cooperative Research and Extension, Elchung Hideyos MA, Palau Community College - Cre, Rose Chamberlain, Palau Community College - Cre, Sasha Kyota, Palau Community College Cre

PALAU COMMUNITY COLLEGE

CRE

STEP-UP
Short-Term Research Experience Program to Unlock Potential

INTRODUCTION

What is *Araceae*?

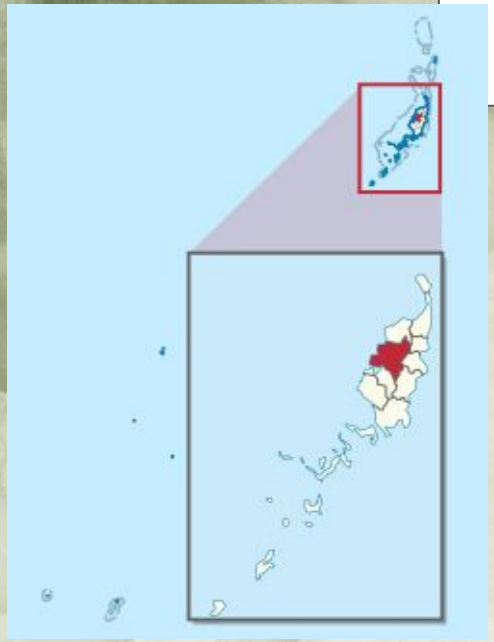
- ***Araceae* (Arum family)** is a large family of tropical **monocot flowering plants**.
- It's characteristic inflorescence is a distinctive **spadix** surrounded by a **spathe** flower structure.
- ***Colocasia, Cyrtosperma, Alocasia***, and ***Xanthosoma*** taro are common in Palau.
- **"Taro"** was borrowed from the Polynesians.
- The word **"Taro"** is now commonly used to describe the only *Colocasia*, but there are many different types of taro.

BACKGROUND

- Taro is a cultural staple food crop in Palau and the Asia-Pacific region
- Local cultivators may differ in composition and processing characteristics, but their nutritional composition is not well documented.
- Spectral comparison for nutrient analysis requires specialized laboratory equipment (ATR-FTIR).

Palauan Proverb: “A mesei a delal a telid”

FACILITIES



Ngeremlengui Research & Development Station

Palau Community College Wetlab/STEP-UP lab

OBJECTIVE

- Estimate the nutritional composition of locally grown taro, giant swamp taro, cassava with commercial starch references using ATR-FTIR spectral fingerprints.

- Compare and identify nutrient profiles and provide baseline data for future validated compositional analysis nutrition and health research.

What is FTIR?

- Fourier transform infrared spectroscopy (FTIR) measures infrared absorption across a range of wavenumbers. Absorption bands arise from molecular vibrations and provide a spectral fingerprint of a sample.

How ATR-FTIR works:

- The powdered sample contacts an attenuated total reflectance (ATR) crystal. The instrument records a spectrum that can be compared across samples and with references.

Important limitation:

- Band assignments are tentative when peaks overlap. Specific compounds or nutrient concentrations require standards, calibration, and reference laboratory measurements.

HYPOTHESIS

- Each locally grown root-crops possesses a highly nutrient-rich composition compared to high complex carbohydrates such as rice, pasta, and other introduced starches. Thus, locally grown taro and cassava carry specific health benefits compared to introduced, foreign starches.

METHODS & MATERIALS

Samples collected from three locations:

- Kukau/taro (*Colocasia esculenta*; *Araceae*) — PCC Mesei
- Brak/giant swamp taro (*Cyrtosperma sp.*; *Araceae*) — Ngeruluobel Mesei
- Diokang/cassava (*Manihot esculenta*; *Euphorbiaceae*) — Ngeremlengui R&D Station
- Cassava was included as a non-*Araceae* root-crop comparator.

Figure 1. Pcc Mesei, Koror

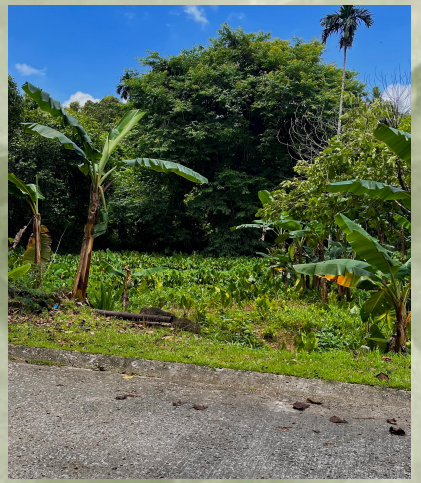


Figure 2. Ngeruluobel Mesei, Airai

Figure 3. Ngeremlengui R&D Station

METHODS & MATERIALS

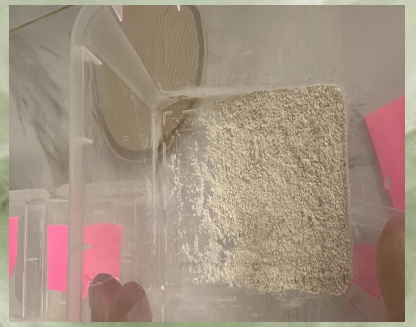
Materials:

- Fresh corm and storage-root samples
- Knife and cutting board
- Drying oven/incubator
- Grinder
- FTIR spectrometer with ATR unit
- Instrument software

METHODS & MATERIALS

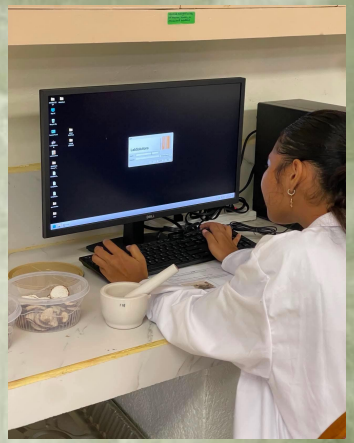
Methods:

Sample Preparation
~Incubated for 48 hours in 65° C
~Grind the dried taro into a fine powder

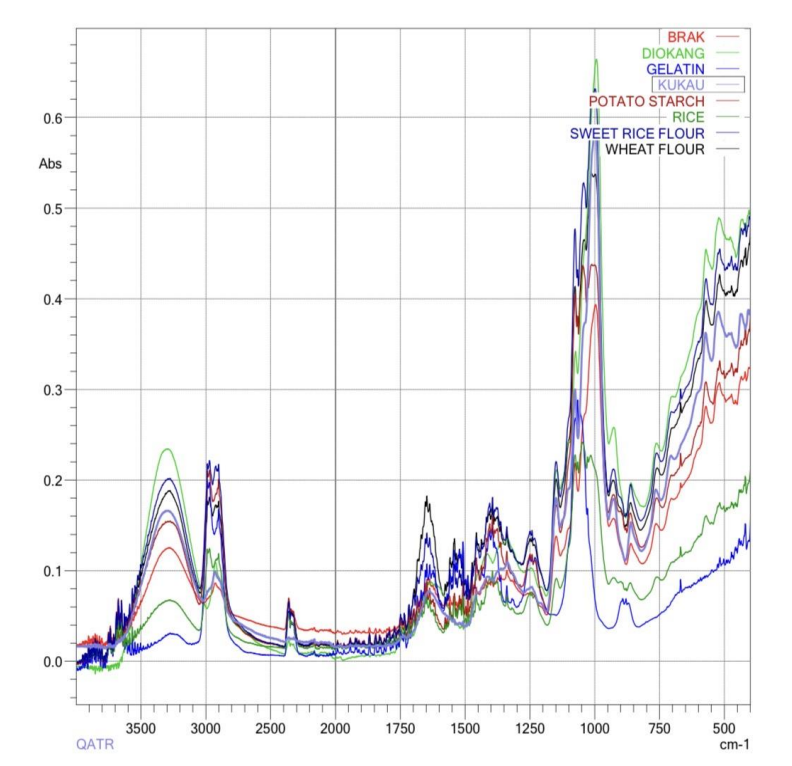


FTIR Analysis

- Place each powdered sample on the ATR crystal.
- Collect the FTIR spectrum using the instrument workflow.
- Compare peak positions and spectral patterns with reference starches and published band regions.
- Treat assignments as preliminary; no quantitative nutrient calibration was performed.



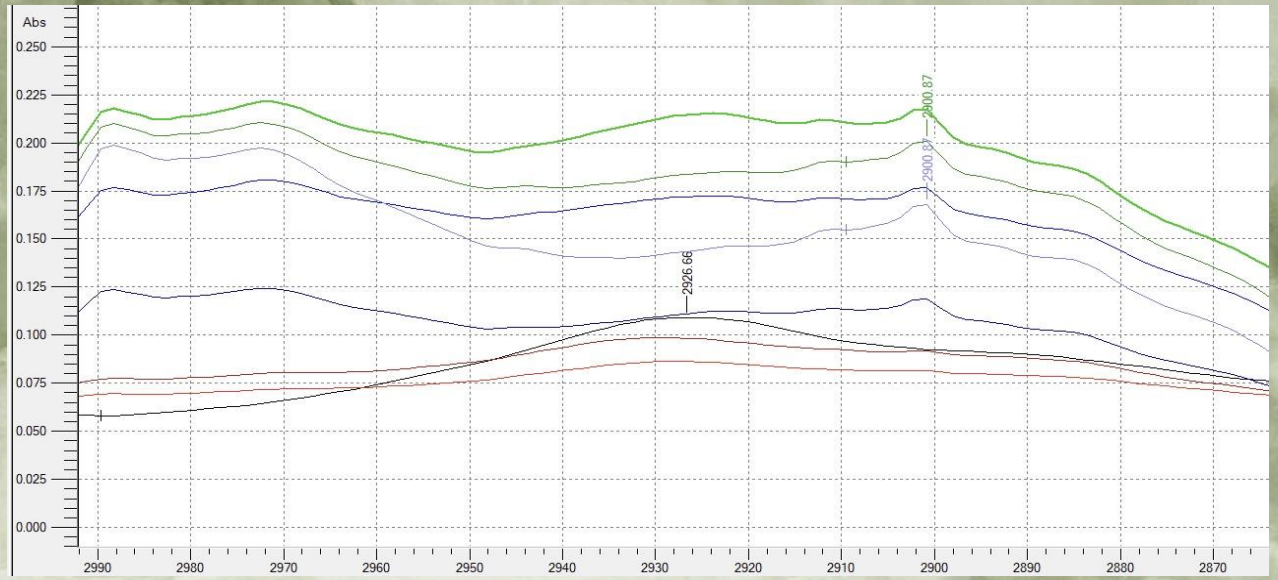
DATA & RESULTS



FTIR Spectrum:

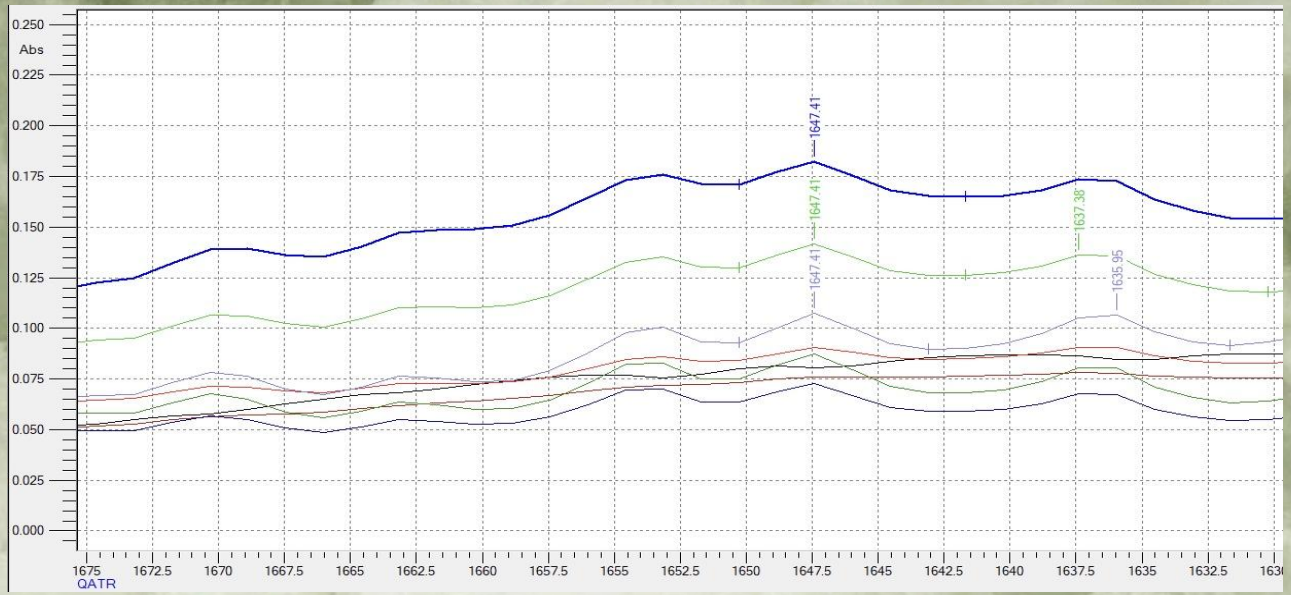
- **X-axis:** wavenumber (cm^{-1}), usually displayed from high to low.
- **Y-axis:** represent the intensity of relative absorbance or transmittance
- Each **peak** shows the sample strongly absorbed the infrared light showing availability of a chemical bond

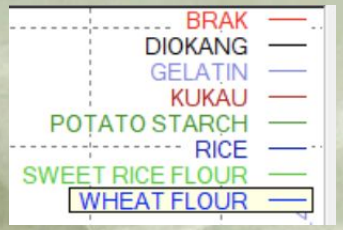
DATA & RESULTS



PEAK NUMBER	CHEMICAL BOND	COMPOUND
2926.66	C-H stretching, CH group	Carbohydrate
2900.87	C-H stretching, CH group	Carbohydrate

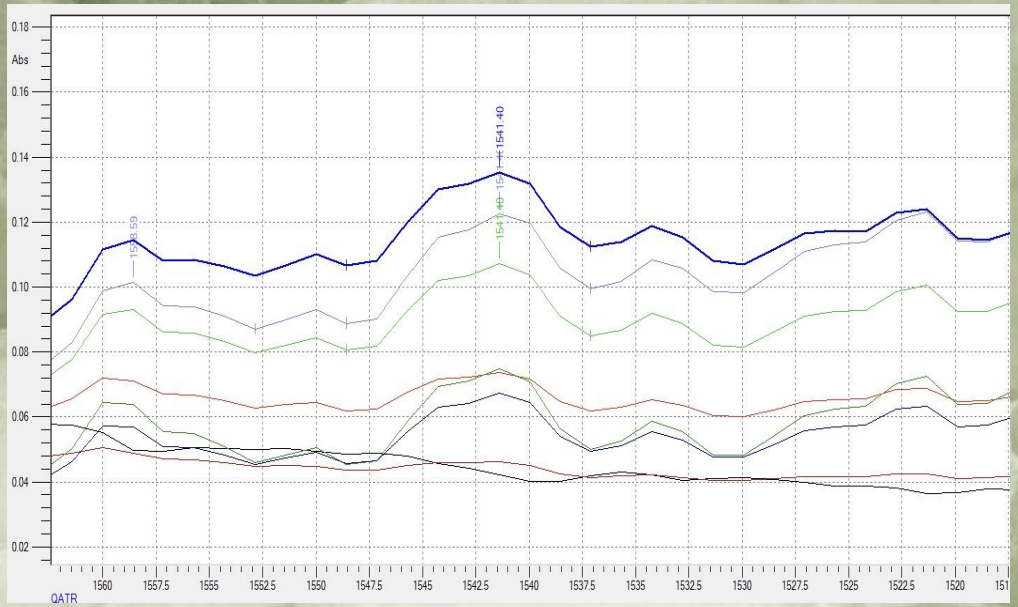
DATA & RESULTS

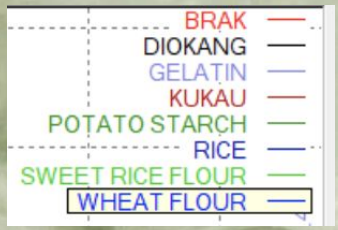




PEAK NUMBER	CHEMICAL BOND	COMPOUND
1647.41	C=C stretching	Alkene
1637.38	C=C stretching	Alkene
1635.95	C=C stretching	Alkene

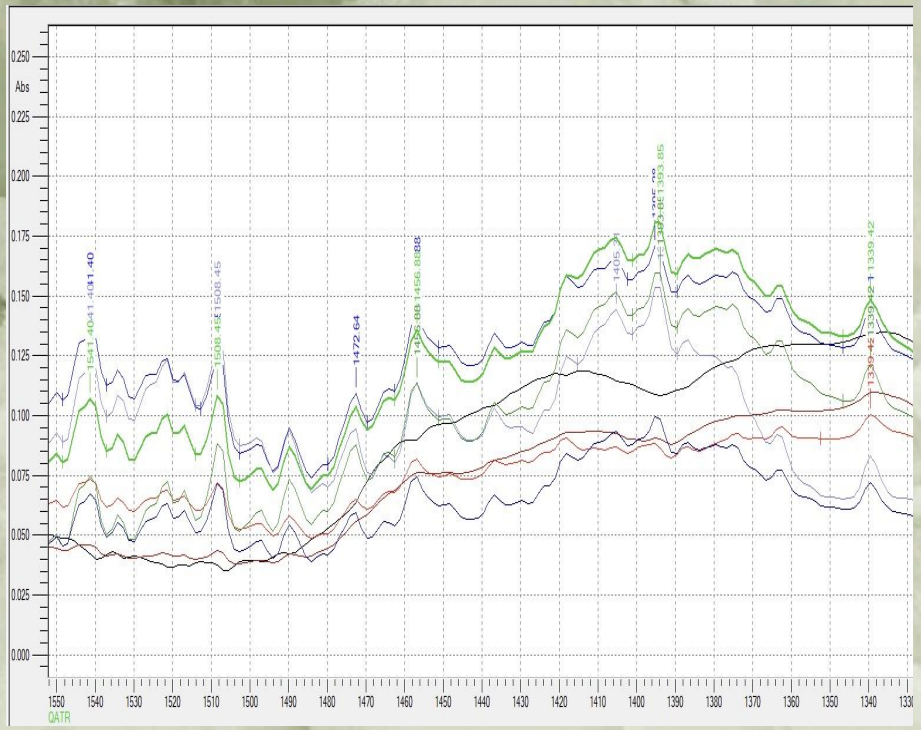
DATA & RESULTS





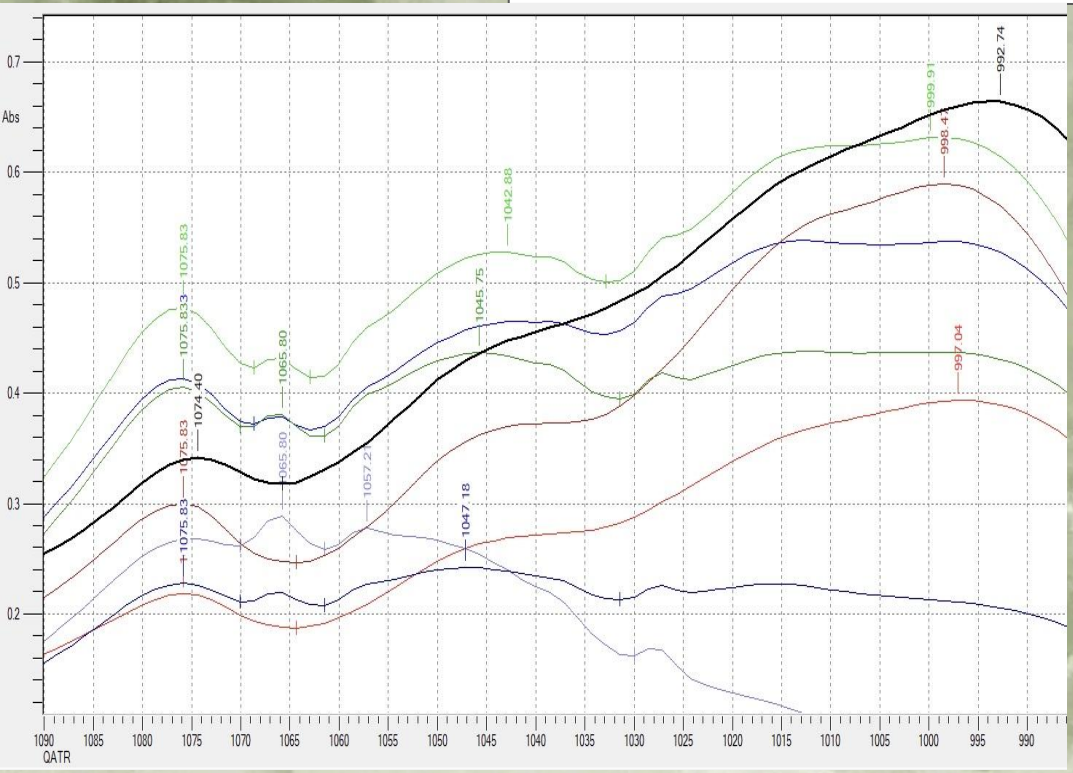
PEAK NUMBER	CHEMICAL BOND	COMPOUND
1558.59	C=C stretching	Cyclic Alkene
1541.40	N-O stretching	Nitro compound

DATA & RESULTS



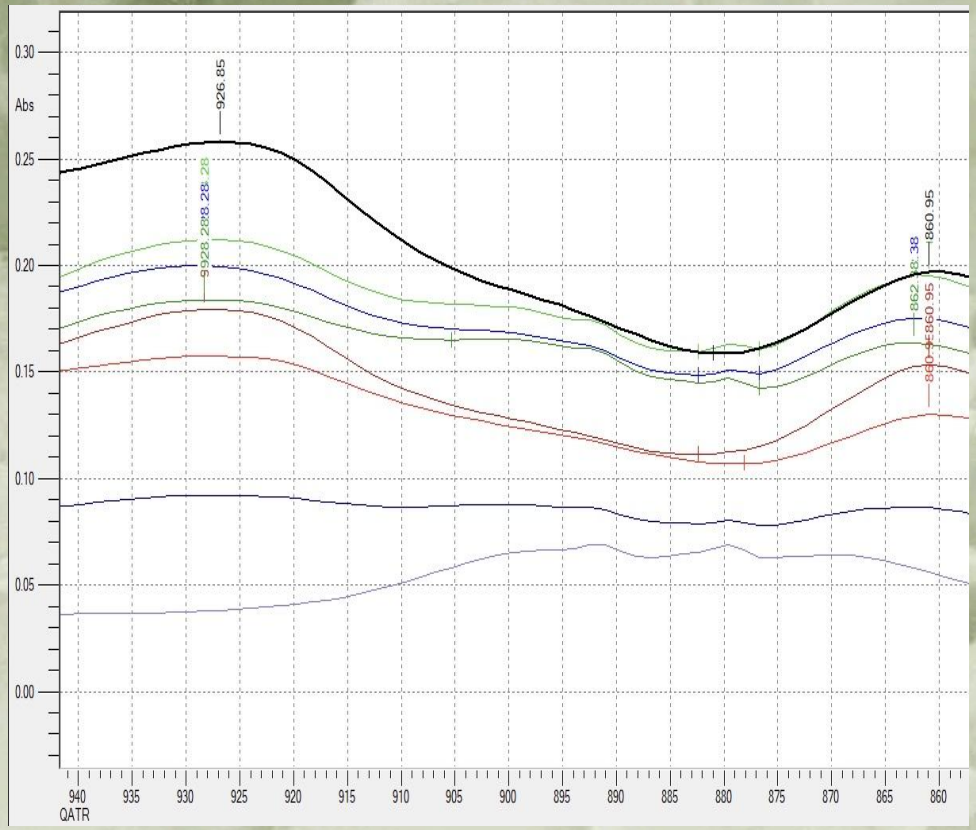
PEAK NUMBER	CHEMICAL BOND	COMPOUND
1541.40	N-O stretching	nitro compound
1508.45	N-O stretching	nitro compound
1472.64	C-H bending	Alkane
1456.88	C-H bending	Alkane
1405.31	C-F stretching	fluoro compound
1395.38	O-H bending	phenol
1393.85	O-H bending	phenol

DATA & RESULTS



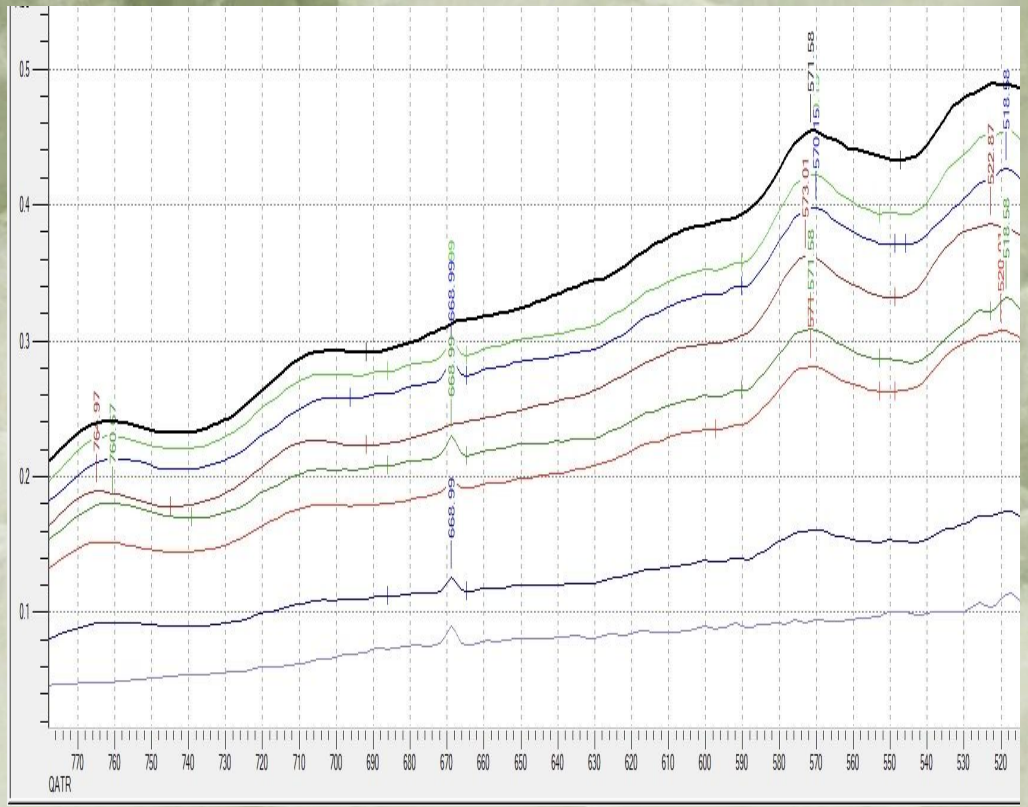
PEAK NUMBER	CHEMICAL BOND	COMPOUND
1075.83	C-O stretching	Primary alcohol
1074.40	C-O stretching	Primary alcohol
1065.80	C-O stretching	Primary alcohol
1057.21	C-O stretching	Primary alcohol
1047.18	CO-O-CO stretching	Anhydride
1047.75	O-H bending	phenol
1042.88	O-H bending	phenol
999.991	C=C bending	allene
998.47	C=C bending	allene
997.04	C=C bending	allene
992.74	C-H out of plane bending	trans-alkene

DATA & RESULTS



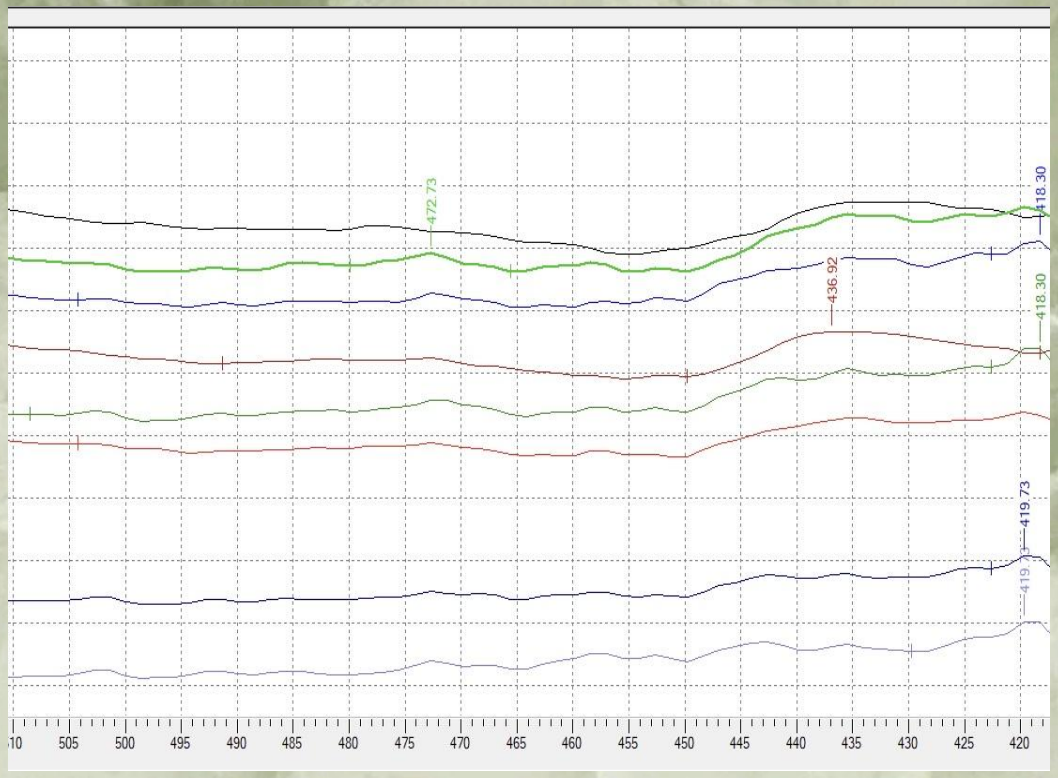
PEAK NUMBER	CHEMICAL BOND	COMPOUND
928.28	C-H bending	1,2,4 trisubstituted benzene
926.85	C-H bending	1,2,4 trisubstituted benzene
862.38	C-H bending	1,2,4 trisubstituted benzene
860.95	C-H bending	1,2,4 trisubstituted benzene

DATA & RESULTS



PEAK NUMBER	CHEMICAL BOND	COMPOUND
764.97	C-H bending	1,2,3 trisubstituted benzene
760.67	C-H bending	1,2,3 trisubstituted benzene
668.97	C-Br stretching	Halo compound
573.01	C-Br stretching	Halo compound
571.58	C-Br stretching	Halo compound
522.87	C-Br stretching	Halo compound
520.01	C-Br stretching	Halo compound

DATA & RESULTS



PEAK NUMBER	CHEMICAL BOND	COMPOUND
472.73	M-O stretching	Metal-oxygen inorganic
436.92	M-O stretching	Metal-oxygen inorganic
419.73	M-O stretching	Metal-oxygen inorganic
418.30	M-O stretching	Metal-oxygen inorganic

CONCLUSION

FTIR identified that rice and potato starch had higher amounts of carbohydrates, and taro had the lowest. Carbohydrates are sugar molecules indicating that rice and potato starch have more sugar than taro. This supports my hypothesis showing that taro is more nutrient-rich and healthy. The method could not provide quantitative nutrient measurements, but provides presence and the availability of nutritional compounds.

FUTURE DIRECTION

- Improve the FTIR protocol to obtain more accurate quantitative nutrient measurements.
- Test more locally grown taro varieties and compare their nutrient composition with introduced starches.
- Use improved methods to better understand the nutritional value and potential health benefits of taro.

REFERENCE

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