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EFFECT OF FUNGI FLORA IN THE NUTRIENT QUALITY OF *Artocarpus camansi* (BREADNUT)

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Abstract

Research on the effect of fungi Flora on the Nutrient quality of Artocarpus camansi was carried out in the department of Plant Science and Biotechnology and food science and Technology Laboratory respectively in the Rivers State University fungal isolates from disease seeds of A.camansi were inoculated into healthy and matured A.camansi seeds and allowed for a period of seven days at room temperature,the samples were re-analysed to check the effects of the fungal pathogens on the Nutrient quality of the seeds is comparison with the control. It was observed that Rhizopus oryzae had the highest moisture value(41.5 ± 0.00) while the least was found in Penicillin italicum (16.2 ± 0.1).Lipid value was the highest in the control (9.1±0.1)and least in R. oryzae (1.4±0). Fibre was highest in P. italicum and R. oryzae (2.5±0.1) respectively and least in the combined fungi (0.8±0) carbohydrate value was highest in Aspergillus flavus (55.5±0.1) and least in combined fungi (30.7±0).The protein content recorded highest value in the R. oryzae (19.5±0.1)and least in the control(15±0).The various fungal isolates also showed varying effects on the mineral composition of the seeds of A.camansi. Calcium values was highest in the control (7.4±0) least in Aspergillus niger (1.4±0.1) Iron was highest in the compared fungi and least in control(0.5+0). Potassium was highest in the A. flavus (14.2±0.1) and least in the control (1.8±0). Result of the vitamin content revealed that the various fungal isolates increased the vitamin A and thiamin values of A.camansi. Generally, the positive impact of fungi on nutrient increment should be exploited by industries to support the demand of quality nutrient food and products.

Keywords: Artocarpus camansi, nutrient quality and fungi flora

INTRODUCTION

Breadnut (*Artocarpus camansi)* is native to New Guinea, and possibly the Moluccas (Indonesia) and the Philippines (Ragone, 2006). Widely scattered in alluvial forests in lowland areas in New Guinea, the fruit is naturally dispersed by birds and bats. In the Philippines and the Caribbean, breadnut is typically grown as a terrace tree as well as a land boundary marker. According to Roberts-Nkrumah, (2012), breadnut is often considered to be a form of seeded breadfruit. However, it is a separate species and the ancestor of seeded and seedless breadfruit (*Artocarpus altilis*).

The breadnut is characterized as a large monoecious tree with a spreading crown with a height of 10-15 meters or taller and a trunk one meter or larger in diameter often growing to a height of 5 meter before branching. Canopy diameter is distinguished as having about half of the tree height. It is a single-trunked tree with spreading evergreen canopy. Breadnut trees are typically integrated with buttresses at the base of the trunk (Ragone, 2006, 2011; Roberts-Nkrumah, 2012).

The leaves are designated as ovate to oblong ovate, coriaceous, 40-60 cm long, and 25- 45 cm wide, bright, dark green, acuminate, deeply pinnate with 4-6 pairs of lobes that are ovate and acute with sinuses cut halfway to the midrib. The densely pubescent leaves are distinguished with many white or reddish–white hairs on upper and lower veins, lower leaf surface and

petiole. The leaf blade is dull green with green veins. Two large green stipules enclose the bud, turning yellow before dehiscing (Roberts-Nkrumah, 2015).

The global demand for breadnut fruit has accelerated dramatically over the past 18 months (FMI, 2020). Furthermore, North America is holding the largest market share for breadnut fruit market due to adaptation in gymnastic and beauty products (FMI, 2020). Global Industry Analysis (2012 – 2016) and Opportunity Assessment (2017 – 2027), projected that due to increasing demand for fibre rich fruits, Asia Pacific will hold maximum market share for breadnut in the near future. Breadnut contains omega-3 fatty acids that can easily control and sustain healthy and balanced levels of cholesterol, reinforce bones build-up and encourage mental health by reduction of the likelihood of bipolar problems (FMI, 2020).

Breadnut is versatile with diverse culinary uses at different stages of maturity. In the Caribbean, mature green fruits including the pulp and immature seeds are cooked with curry, coconut milk and even meat forming an exotic meal with roti or rice. At the cottage level, the sweet granular layer on the fruit core as well as the seedless pulp are used to make milk based beverages (Mohammed &Wickham, 2011).
The study is aimed at assessing the effect of various fungal organisms on the nutrient quality of *A. camansi*.

MATERIALS AND METHODS

Sample collection and preparation

A. camansi was obtained from Ozuaha all in Ikwerre Local Government Area of Rivers State. Freshly harvested matured unripe fruits were washed with clean water and transported immediately to the laboratory for proximate, mineral, vitamin and phyto-chemical content analysis. Diseased samples were also washed and packaged with sterilised polythene bags and taken to the laboratory for the isolation of microorganisms. The diseased breadnut were rinsed in distilled water and sterilised with 70% ethanol and cut open with a sterile knife. The cells of the diseased parts were disrupted using sterile mortar and pestle and 1.0g of each sample was made. (Obire, Wekhe and Azaiki, 2016; Chuku and Wekhe, 2017).

Mycological Studies

Preparation of Mycological Medium

All experimental materials such as conical flasks, petri dishes, test tubes and slides were washed with detergent and rinsed thoroughly with water and sterilized in the oven at 120°C for an hour while other equipments were surfaced sterilized with 70% ethanol to reduce microbial contamination (Agrios, 2005). Inoculating loop and scalpels were sterilized by dipping for 20 seconds in 70% ethanol and heated to red hot. The mycological medium used was Sabouraud Dextrose Agar prepared in a conical flask using the standard method. The mouth of the flask was plugged with non-absorbent cotton wool and wrapped with aluminium foil. The conical flask containing the mycological medium was autoclaved at 121o C and pressure of 1.1kg cm-3 for 15 minutes. The molten agar was allowed to cool to about 40 o C and dispensed into Petri dishes at 15mls per plate and allowed to further cool and solidify.

Isolation of Fungi from *Artocarpus camansi*

One gram of *Artocarpus camansi* sample showing visible signs of spoilage by moulds was inoculated onto Sabouraud Dextrose Agar in Petri dishes onto which an antibiotic ampicillin was added to hinder the growth of bacteria in triplicate. The inoculated plates were incubated for 5 days at ambient temperature of 25o C ± 3o C (Chuku, 2009; Samson, Hoeskstra and Van Oorschot, 1981). The entire set up was observed for 7 days to ensure full grown organisms. Pure cultures of isolates were obtained after a series of isolations**.**

Identification of fungal organisms from *Artocarpus camansi*

Microscopic examination of fungal isolates was carried out by the needle mount method (Cheesebrough, 2000). The fungal spores were properly teased apart to ensure proper visibility. The well spread spores were stained with cotton blue in lacto phenol and examined microscopically using both the low and high power objective. The fungi were identified based on their spore and colonial morphology, mycelia structure and other associated structures using the keys of (Samson *et al.*, 1981, Olds, 1983).

Pathogenicity studies

Pathogenicity studies was carried out on *Artocarpus camansi* to check if the fungi isolated from *Artocarpus camansi* were capable of causing spoilage of the freshly harvested fruits. The method of (Agrios, 2005, and Trigiano, 2004) was basically followed. The fungal isolates were introduced into *Artocarpus altilis* and observed for seven days. The set up was monitored regularly for growth.

Determination of nutrient components of *Artocarpus camansi* treated with the various test fungi.

The treated fruit samples of *Artocarpus camansi* were sent to the Food Science and Technology Laboratory for the determination of nutrient composition. The methods of AOAC (2005) were used for the analysis and was carried out for within a period of six months (August, 2020 to January, 2021).

RESULTS AND DISCUSSION

Table 1 Effects of the Isolated Fungi on the Proximate Composition of *A. camansi*

Seed Samples of Bread Fruit	Fungi	Proximate Composition					
		Moisture %	Ash %	Lipids %	Fibre %	CHO %	Protein %
A. camansi	Control	23.1 ± 0^{b}	3.8 ± 0^{d}	9.1 ± 0.1^{e}	1.5 ± 0^{c}	47.5 ± 0^{d}	15 ± 0^{a}
	Combined fungi	40.1 ± 0^{d}	1.4 ± 0^{a}	4 ± 0^{b}	0.8 ± 0^{a}	30.7 ± 0^{a}	16 ± 0^{b}
	Aspergillus flavus	16.2 ± 0.1^{a}	3 ± 0^{c}	7.5 ± 0.1^{c}	1.6 ± 0.1^{c}	55.5 ± 0.1^{f}	16.2 ± 0.1^{c}
	Aspergillus niger	24.1 ± 0.1^{c}	3.8 ± 0.1^{d}	8.9 ± 0^{d}	1 ± 0^{b}	46 ± 0^{c}	16.2 ± 0.1^{c}
	Penicillum italicum	16.2 ± 0.1^{a}	2.9 ± 0^{b}	7.5 ± 0.1^{c}	2.5 ± 0.1^{d}	52.5 ± 0.1^{e}	18.5 ± 0.1^{d}
	Rhizopus oryzae	41.5 ± 0^{e}	1.4 ± 0^{a}	3.1 ± 0^{a}	2.5 ± 0.1^{d}	32 ± 0^{b}	19.5 ± 0.1^{e}
	p value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Significant Difference	Yes	Yes	Yes	Yes	Yes	Yes

Means with different superscripts within the same row are significantly different ($P \leq 0.05$)
Legend: CHO= Carbohydrate

Table 2 Effects of the Isolated Fungi on the Mineral Composition of *A. camansi*

Seed Samples of Bread Fruit	Fungi	Mineral Content (mg/100g)					
		Ca	Fe	Mg	P	K	Na
A. camansi	Control	7.4 ± 0^{f}	0.5 ± 0^{a}	4.1 ± 0^{e}	3.2 ± 0^{a}	1.8 ± 0^{a}	3.2 ± 0.1^{b}
	Combined fungi	5.4 ± 0^{d}	8.4 ± 0^{f}	2.3 ± 0^{b}	5.3 ± 0^{bc}	14 ± 0^{e}	2.9 ± 0^{a}

Aspergillus flavus	4.7±0.1^{c}	5.1±0^{e}	2.3±0.1^{b}	5.8±0^{e}	14.2±0.1^{f}	4±0^{d}
Aspergillus niger	1.4±0.1^{a}	4.5±0.1^{c}	3.6±0.1^{d}	5.2±0.1^{b}	4.1±0^{b}	3.6±0.1^{c}
Penicillum italicum	3.4±0.1^{b}	4±0^{b}	1.2±0.1^{a}	5.4±0.1^{cd}	5.01±0^{c}	3±0^{a}
Rhizopus oryzae	5.9±0^{e}	4.8±0^{d}	2.5±0^{c}	5.5±0^{d}	12±0^{d}	3.3±0.1^{b}
p value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Significant Difference	Yes	Yes	Yes	Yes	Yes	Yes

Means with different superscripts within the same row are significantly different ($P \leq 0.05$)
Legend: Ca= calcium; Fe= Iron; P= Phosphorus; K=Potassium; Na= Sodium and Mg= Magnesium

Table 3 **Effects of the Isolated Fungi on the Vitamin Composition of *A. camansi***

Seed Samples of Bread Fruit	Fungi	Vitamins (mg/100g)		
		Vitamin A	Vitamin C	Thiamin
A. camansi	Control	0.15±0	.±.	0.12±0
	Combined fungi	1.5±0	15±0	.±.
	Aspergillus flavus	30±0	2.4±0.1	0.51±0
	Aspergillus niger	41±0	2.4±0.1	0.3±0.1
	Penicillum italicum	43±0	2±0	0.05±0
	Rhizopus oryzae	35±0	4±0	0.3±0
	p value		<0.0001	<0.0001
	Significant Difference	Yes	Yes	Yes

The result of the effects of isolated fungi on the proximate composition of *A. camansi* (Table1) showed that the various fungal isolates increased the moisture content of *A. camansi* except for *A. flavus* and *A. niger* while moisture content were significantly (P≤0.05) lower (16.2%) than the control (23.1%). The increase in moisture was in line with Chuku (2009), and Chuku and Wekhe (2017). There was reduction in the ash content except for *A. niger* that had same value with the control (3.8±0). There was reduction in lipid content. For fibre, there was increase in fibre content except for *A. niger* and combined fungi that had values (1±0 and 0.8±0) lower than the control (1.5±0). There was increase in the carbohydrate content except for *Rhizopus orizae,* combined fungi and *A. niger* that had values (30.7±0- 46±0) lower than the control (47.5±0). This result is also in line with Chuku and Barber (2013) and Chuku and Wekhe (2017). This result revealed that the fungi isolates compete for food in order to survive. There was increase in the protein content which could be due to the ability of the organism to secrete some enzymes which in turn increased the protein content (Chuku, Onuegbu and Osakwe, 2004).

The calcium content of *A. camansi* inoculated with different fungi ranged from (1.4±0.1-5.9±0) and was significantly (P≤0.05) lower than the control (7.4±0).
The iron content of *A. camansi* inoculated with the different fungi ranged from (4±0-8.4±0) which was significantly higher (P≤0.05) higher than the control (0.5±0). This result showed that the presence of these fungi greatly increased the iron content of *A. camansi* and it disagrees with the effects of fungi flora of *A. altilis* on the nutrient components reported by Chuku and Wekhe, (2017) and the effects of *Rhizopus*

stolonifer on the biochemical composition of tomatoes (*Lycopersicone esculents*, Mill) reported by Chuku and Emelike, (2013). The magnesium content of *A. camansi* inoculated with different fungi ranged between (1.2±0.1 – 3.6±0.1) and significantly (P≤0.05) lower than control (4.1±0). This result is in line with the Chuku, Azuonwu, Munonye, Jaja and Ojugo, (2007) and Chuku and Emenike, (2013). The phosphorus content of *A. camansi* inoculated with different fungi ranged between (5.2±0.1– 5.8±0) and was significantly (P<0.5) higher than the control (3.2±0.) This result disagrees with Chuku and Wekhe, (2017) on phosphorus content of *A. altilis* inoculated with different fungi. The potassium content of *A. camansi* inoculated with different fungi ranged between 4.1±0 – 14.2±0.1 and was significantly (P≤0.05) higher than the control (1.8±0). This result also disagrees with Chuku and Wekhe, 2017. The sodium content of *A. camansi* inoculated with different fungi recorded increase except for combined fungi and *Penicillium italicum* that had values (2.9±0 and 3±0) lower to the control (3.2±0.1).

The effect of the isolated fungi on the vitamin composition of *A. camansi* is seen in Table 3. The presence of these fungi increased the vitamin A content of *A. camansi* inoculated with different fungi (1.5±0 – 43±0) and was significantly (P≤0.05) higher than the control (0.15±0). There was also increase in vitamin C content (2±0 – 15±0) while control had no value. The thiamine content increased except for *P. italicum* that had values (0.05±0) lower to the control (0.12±0). Meanwhile there was no value for the combined fungi. The result is in line with Chuku and Akani, (2015).

CONCLUSION

The study has shown that the various fungal organisms have varying influence on the quality of breadnut. However, diseased breadnuts should not be consumed to prevent the build up of fungi in the body which could be of grave consequences.

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