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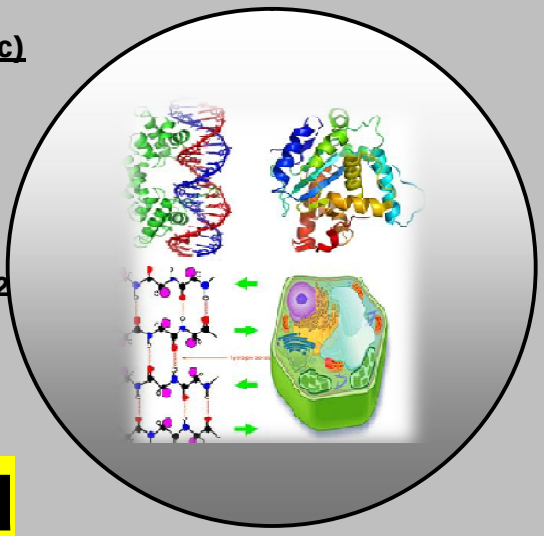

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http:// www.jbcr.in
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Studies on the Post-Harvest Fungal Pathogens Associated with Post-Harvest Decay of Local Pear (*Dacryodes edulis*)

C. Odo and O. F. A. Ibiam
Department of Applied Biology, Ebonyi State University, Abakaliki, Nigeria

ABSTRACT

Isolation and identification of fungi associated with biodegradation of the fruits of the local pear: Dacryodes edulis, and the effect of these fungi on the nutrient values of the fruits was investigated. Rhizopus Stolonifer and Bisporus sp were isolated from the infected fruits of Dacryodes edulis, and the result of the pathogenicity test showed that the two fungi were implicated in the post-harvest soft rot of the fruits, R stolonifer, being more pathogenic. The results observed showed that Fibre and Ash compositions were relatively higher in the infected fruit than apparently healthy fruits. Moisture, lipid protein and carbohydrate composition of apparently healthy fruits were higher than that of infected fruit. However, the correlation test carried out showed that there was no significant difference between the result of the infected and apparently healthy. Alkaloid, flavonoid and saponin in apparently healthy fruits were higher than percentage composition of infected fruits, while cynogenic glucoside and tannin concentrations were the same in the infected and apparently healthy fruits. Correlation test carried out showed that there was no significant difference between the result of the infected and apparently healthy fruits (P>05). Sodium, potassium, Zinc, potassium and lead concentration of apparently healthy fruits were higher than those of infected fruits and magnesium, while calcium, manganese and cupper in apparently healthy fruits were greater than those in the infected. Iron was not detected. Correlation test carried out showed that there was no significant difference between infected and apparently healthy fruits (P>05). Phosphorous and nitrate compositions of infected fruit were greater than than those in apparently healthy fruits. Nitrogen concentrations in apparently healthy fruits were greater than those in infected fruits. There was no significant difference between the apparently healthy and the infected (P>05).
Key word: Decay, Fruits, Pathogens, Pear, Post-Harvest.

INTRODUCTION

Dacryodes edulis is a traditional food plant in Africa, and has a potential to improve nutrition and boost food security (Ayuku *et al.,* 2000). Its fruit can be eaten either raw or cooked in salt water or roasted. Cooked flesh of the fruit has a texture similar to butter, and the pulp contains 48% oil (Ejiofor *et al.,* 1996). Oil Composition of the fruits of *Dacryodes edulis* is a rich source of amino acid triglycerides (triacylglycerols) (Ekundayo *et al*, 1996). It is also rich in vitamins, and the kernel can be used as fodder for sheep or goats, while the flowers are useful in apiculture and the oil of fruits of *Dacryodes edulis* is a rich source of amino acid triglycerides (triacylglycerols) (Ekundayo *et al*, 1996). The resin is sometimes burnt for lighting or used as an ornamental plant, and is known to improve soil quality by providing large quantities of biomass (Okafor *et al*, 1996).

The plant has long been used in the traditional medicine of some African countries to treat various ailments such as wound, skin disease, dysentery and fever; and the extracts and secondary metabolites have been found to show biological activities such as antimicrobial, antioxidant and anti sickle cell-cell anemia and a wide range of chemical constituents such as terpenes flavonoids, tannins, alkaloid and saponins have been isolated from the plant. (Gatumbi, 1990).

In Nigeria,35-65% of the fruit were attacked by four post-harvest rots fungi, and *Botryodiplodia theobromae* and *Rhizopus srolotnifers* were important, accounting for 80% of the affected fruit, among other post-harvest fungi: *Aspergellus niger*, *Mucor stolonifer*,*Rhizopus nigricans*,*Luxurian schroeter* and *Rhizopus artocarpi* (Gatumbi, 1990). Akwawo *et al*(2000), reported the presence of Moisture, Crude protein, Lipid, Ash, Crude fibre, Carbohydrate, Vitamin, Iron (Fe), Copper (Cu), Sodium (Na), Potassium (K), Zinc (Zn), Calcium (Ca), Phosphorous (P), Phosphorous (P), Cadmium (Fe), Lead Pb in the fruits of the plant. Moisture content determines the stability and quality of foods , and is of a great important to food processor as a number of biochemical reaction and physiochemical changes in food depend very much on the moisture content (Onwuka, 2005).

As a result of various uses to which the fruits of this plant have been put, several researches have been done on the isolation of fungi associated with soft rot of the fruit and the proximate and phytochemical compositions. However, the effect of the fungi that attack these fruits on the nutrient composition has not been done quantitatively,hence, this work is aimed at the isolation of fungi associated with the soft-rot of the fruit, and their effect on the nutrient composition of the fruit.

MATERIAL AND METHODS

Source of sample

Samples of *Dacryodes edulis* fruits used in this work were plucked from its tree at Ngbo in Ohaukwu Local Government Ebonyi State – Nigeria.

Isolation of fungi

The plucked fruit samples were kept in the house for 7days for it to be rotted due to the activity of fungi. The work bench was cleaned with 70% ethanol. The rotted fruits also were, washed and surface sterilized with 70% ethanol. Some part of the fruits were cut some 2mm away from the rotted part and cut into small piece of $4mm^2$ with sterile scalpel. The cut pieces of the fruit were placed on freshly prepared Patato Dextrose Agar (PDA) media (about 5 pieces per Petri dish) and incubated in the incubator at 25 ± 2^0C for 48hours. After 48hours, the fungal isolates were sub-cultured into pure culture and identified based on their habit and spore characteristics with the help of manual by Barnett and Hunter, (2000).

Pathogenicity Test

Proximate and Phyto-chemical analysis

These were done following the methods in A. O. A. C. (1984) Manual**.** Samples of apparently healthy and rotted fruits of *Dacryodes edulis* were used in this analysis

PROXIMATE COMPOSITION ANALYSIS

DETERMINATION OF MOISTURE

About 1g sample of the rotted and apparently fruits of *Dacryodes edulis* weighed into a clean dried porcelain evaporating dish. This was placed on an oven regulated at 105^0C for 6hrs. The evaporating dish was cooled in desiccators to room temperature consequently reweighed and recorded. Then weight of moisture was calculated by subtracting fresh sample weight from dried weight sample.

$$\% \text{ moisture} = \frac{\text{fresh weight} - \text{dried weight}}{\text{Weight of fresh sample}} \times \frac{100}{1}$$

DETERMINATION OF ASH

About 1g of sample was weighed into porcelain crucible that was previously preheated and weighed. The crucible was inserted into a murphle furnace and regulated to a temperature of 630^0C and consequently heated for 3 hrs and allow cooling to room temperature and reweighed.

$$\% \text{ Ash} = \frac{\text{weight of crucible} - \text{weight of empty crucible + Ash}}{\text{Weight of sample}} \times \frac{100}{1}$$

DETERMINATION OF LIPID

About 2g samples were inserted into paper, than placed into a sox let extractor. The extractor was placed into pre-weighed dried distillation flask. Then acetone was introduced into distillation flask via the condenser end attached to sox let extractor, the set up was held in place with a retort stand clamp. Cooled water jet was allowed to flow into condenser and heated solvent was refluxed that result the lipid in the sox let chamber was extracted in the process of continuous refluxing, when the lipid was observable extracted from the sample under test, the solvent was evaporated to concentrated lipid.

The flask was than dried with air oven to constant weight and reweighed to obtain the weight of the lipid. `

% of lipid = $\frac{\text{weight of flask\& extract – weight of flask}}{\text{Weight of sample extracted}} \times \frac{100}{1}$

DETERMINATION OF PROTEIN

About 1g sample was weighed into a conical flask of 250ml capacity 3g digestion catalyst was added and 20mls concentration H_2SO_4 was also added and the flask was heated to digest the contents from black to sky blue coloration, the digest was cooled to room temperature and diluted to 100ml with distilled water.

Distillation

20ml diluted digest was measured into a distillation flask and the flask was held in place on an electro – thermal heater hot plate. The distillation flask were attached a Lie big condenser connected to a receiver adaptor containing 10ml 2% boric acid indicator, 40% NaOH was injected via a syringe attached to mono – arm steel head until digest become strongly alkaline. The mixture was heated to boil and distilled the ammonia gas via the condenser into a receiver beaker. The colour of boric acid changing from greenish to purple as ammonia distilled was introduced into the boric acid.

Titration: The distillate was titrated with 0. IN HCL acid back to purple from greenish. The volume of HCL that changes the colour was recorded as the titre value.

Than % N_2 = $\frac{\text{titre value x 1. 4 x 100 x 100}}{\text{100mg x 0. 1 x 20}}$

% protein = % N_2 x 6. 25

Titre value = the volume of HCL used in titration

1. 4 = N_2 equivalent to Normality of HCL used in titration

100 = Total volume digest was made up

100 = % Factor

1000 = Conversion factor from to mg

20 = Aliquot volume of digest digested

DETERMINATION OF CARBOHYDRATE

About 0.1g sample was weighed into 25ml volumetric flask 1. 3ml 62% perchloric acid was added and shaking for period of 20 minutes to homogenized completely. The flask was made up with distilled water and stoppered. The solution formed was filtered with glass filter paper or allow to sediment and decanted. Then 1ml of the filtrate was collected and put into a 10ml volumetric flask. This was diluted to volume with distilled water. 1ml of the solution was pippetted into a clean test tube and 5 mls Anthrone reagent was added.

1 ml distilled water and 5mls Anthrone reagent was mixed similarly and the whole mixture where read at 630nm wavelength using distilled water as blank. A standard glucose of 0.1mg/ml was prepared and treated as the sample with anthrone reagent was added 1 ml distilled water and the whole mixture were read at 360nm. Wavelength using distilled water as blanks. A standard glucose of 0.1mg/ml was also prepared and treated as the samples with Anthron reagent. Absorption of the standard glucose was read and the value of carbohydrate as glucose was calculated using the formula

$$\% \text{ CHO as glucose} = \frac{25 \times \text{Abs of sample}}{\text{Abs of standard} \times 1 \text{ glucose}} \times \frac{100}{1}$$

DETERMINATION OF FIBRE

The residue from oil analysis (de- oiled sample) was dissolved in 200mls of 0. 255m $H_2 S0_4$ and heated for one hour. It was filtered while hot with a Buchner funnel under suction. The residue was transfer into a flask of 0. 313N NaOH added. The mixture was heated further for 1 hour. The mixture was filtered and funnel. The residue collected was placed in a crucible and burnt to ash in a muffle furnace. Then the ash was cooled and weighed.

$$\% \text{ Crude fibre} = \frac{Y - 2}{x} \times \frac{100}{1}$$

X = Weight of sample
Y = Weight of crucible content
Z = Weight of empty crucible

PHYTOCHEMICAL ANALYSIS:

Anti-nutrient tested includes:-

1. Tanin
2. Cynogenic Glycosides
3. Alkaloid
4. Flavonoid
5. Saponin

DETERMINATION OF TANNIN

About 0.1g sample was weighed into a clean conical flask. 100ml water was added and boiled for 1hr. the sample was filtered and made up to 50ml with distilled water. 1ml of this solution was pipetted into a clean test tube and 2. 5ml Folin Dennis solution was added, 1ml 7% of sodium carbonate, this was allowed to stand for 20 minutes for proper colour development. A standard tannic acid was prepared and treated as to the sample. The absorbance of the colours was read at 630nm wavelength using a blank. The concentration of the tannin in sample was extrapolated from standard tannic acid graph.

DETERMINATION OF CYNOGENIC GLYCOSIDE

About 10g of the sample was weighed to pass Number of 20 sieve in 800ml Kjedahl flask, 200ml of water were added and it was allow to stand for 2 – 4hr, then the mixture were steam distillate, 150ml of the distilled was collected into NaOH solution and diluted to a 250ml with distilled water and this were titrated with 0.2N $AgN0_3$, using microburet. The end point is faint but permanent turbidity and easily reorganized, especially against black background. 1ml 0.02N $AgN0_3$ = 1. 08mg HCN (Ag equiv to 2CN)

DETERMINATION OF ALKALOID

About 5g of sample was weighed into 250ml beaker and 200ml of 10% Acetic acid in ethanol was added and covered and allow to stand for 4hrs. This was filtered and the extracted was concentrated on a water bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitate was collected and washed with dilute ammonium hydroxide and then filtered. The residue which was dried and weighed, Calculated by:

$$\text{Alkaloid} = \frac{\text{Weight of flask and sample residue – weigh of empty flask}}{\text{Weight of sample used}}$$

DETERMINATION OF FLAVONOID

About 10g of the sample was extracted repeatedly with 100ml of 80% aqueous methanol at room temperature. The whole solution was filtered through whan man filter paper. The filtrate was later transferred into crucible and evaporated into dryness over a water bath and weighed to a constant weight calculation.

$$\Rightarrow \frac{\text{Weight of flask and sample residue – weight of empty flask}}{\text{Weight of sample used}} \times \frac{100}{1}$$

DETERMINATION SAPONIN

Of extract in test tube was vigorously shaken with water for some time; persistent fruiting showed the presence of saponin A 2.500mg of extract was placed a fresh prepared blood agar plate and left to stand for 6hrs coagulate haemolysis of the blood around the extract indicated presence of saponin glucosides.

DETERMINATION OF VITAMIN C

About 0.1g sample was extracted with 10% Acetric acid (glacial) 10ml of this solution was titrated with 0.01% indophenols to a permanent pink coloration. 0. 1g ascorbic acid was also dissolved in 100ml with 10ml was titrated with 2, 6 dichloropenol indophenol to a permanent pink. The values were recorded and used to calculate the concentration of vitamin C in the sample.

CALCULATION

Standard vitamin C = 0.01
Volume of vitamin C = 100ml
Aliquot titrated = 25ml
Titrated value = 53. 0ml
25 Vitamin C = 53. 0ml indophenol
100 ml V. C 53. 0 x $\frac{100}{25}$ $\frac{}{1}$
= 212 ml indophenol

0.0lg V. C = 212 indophenol

But in 100ml V.C = 0. 0lg V. C
∴ 212 indophenol = 0. 0lg V. C
0.5 ml = 0.01g x $\frac{0.5}{212}$ $\frac{}{1}$ = 2.35841×10^{-5}
2.35849×10^{-5} = 0.1g sample
1000g = $\frac{2.38849}{0.1} \times 10^{-5} \times \frac{100}{1}$
= 0. 235849g/kg
Non-infected = 235. 85 mg /kg

ANION ANALYSIS

DETERMINATION OF NITROGEN

The sample was weighed into a clean conical flask. 3g digestion catalyst was added into the flask and 20ml concentrated sulphuric acid was also added and the flask was heated to digest the content from black to sky blue colouration. The digest was cooled to room temperature and was diluted to 100ml with distilled water.

Distillation

Under distillation, 20ml distilled digest was measure into distillation flask and the flask was held in place on the electric thermal heater hot plate, the distillation flask was attached to Lei big condenser connected to receiver adapter containing 10ml 20% boric acid indicator, 40% sodium hydroxide was injected into the digest via syringe attached to the mono arm steel head until the digest became strongly alkaline. The mixture was heated to boil and distilled ammonia gas via the condenser into receiver beaker. The colour of boric acid changes from purple back greenish as ammonia distillate was introduce into boric acid

Titration

The distillate was titrated with standard 0.1N hydrochloric acid solution back to purple from greenish the volume of hydrochloric acid added to effect this change was recorded as titre value

$\% N_2 = \frac{\text{titre value} \times 1.4 \times 100 \times 100}{1000\text{mg} \times 20.0 \times 0.1\text{g}}$

Titre value = the volume of HCL using titration
1. 4 = N_2 equivalent to Normally of HCL used in titration
100 = Total volume digest was made up
100 = % factor
1000 = Conversion factor from of to mg
20 = Aliquot volume of digest diseased sample

DETERMINATION OF NITRATE

About 1g sample was extracted with 50 ml 2.5% Acetic acid. This was filtered into clean beaker and 1 ml was pipetted into test tube with 0.5ml Brucin reagent added. 2mls concentrated sulphuric acid was added to develop a yellowish colour in the presence of $N0_3$ ion. The colour formed was absorbed at 400nm using water as blank.

Standard nitrate was prepared by dissolving 0.7216g potassium Nitrate in 100ml distilled water and diluted 10 times to obtain a working standard of 0.1mg $N0_3$ per ml.

DETERMINATION OF PHOSPHOROUS

About 1g of the sample was extracted with 50ml 2.5% glacial acetic acid. The extract was filtered into comical flask and 8. 0 ml of combined reagent was added into the flask. A black and standard phosphate ion concentration ranging from 0.0001 to 0.0007 was prepared and 0.8ml combined reagent was added respectively. The bluish colour develop within 30min interval was read at 840nm wavelength in thermo spectrophotometer. The sample extract volume developed was also read at the same wavelength. The concentration of the phosphate ion in the sample was extrapolated from the standard phosphate graph plotted value in the table displayed.

MINERAL ANALYSIS (CATION)

The minerals covered in the course of this work were analyzed by Atomic Absorption spectrophotometer.

ATOMIC ABSORPTION SPECTROPHOTOMETER METHOD

The digest were aspirated into Atomic Absorption spectrophotometer burner. After it will be calibrated using standard solution of respective metal to be tested. Then the hollow cathode lamp was given adequate time to stabilize and other setting according to the operational manual of the Atomic Absorption spectrophotometer.

ANALYSIS OF METALS

About 1g sample was digested with combined acids (Perchloric Acid 5mls and 10ml of Nitric Acid). The digest was diluted to 50ml with distilled water and filtered. The filtrate was analyzed for various metal ions by Atomic Absorption spectrophotometer.

SODIUM

589nm wavelength was selected Air and gas pressure was adjusted slit width and other settings as recommended for equipment employed was adjusted. The instrument was calibrated with standard sodium ion concentration to obtain a standard ion graph. The samples was aspirated into the instrument and its concentration obtained by extrapolation from the standard graph in mg / L or ppm.

POTASSIUM

766nm wavelength was selected, slit width, air and gas pressure was adjusted. Other vital setting, as recommended for instrument employed were programmed standard potassium ion concentration were aspirated into the instrument burner chamber to calibrate the equipment and to plot graph of the standard ion.

MAGNESIUM

285.2nm wavelength was selected in the instrument Air and gas pressure flow was adjusted. Slit and other setting as recommended for instrument lamp was also adjusted. Hollow cathode lamp was also energized by allowing adequate time, standard magnesium ion concentration were aspirated into the instrument as to effect caliberation and plotting of standard graph. The sample solution was aspirated into the instrument and concentration of test ion was extrapolated from the standard graph in mg/L

CALCIUM

422. 7nm wavelength was selected Air and gas pressure was regulated slit width and other setting as recommended for the instrument employed was adjusted. Hollow cathode lamp was given adequate time to stabilized. Standard concentration of calcium ion was aspirated into the equipment for calibration and for the plot of standard graph. The sample was aspirated within the same condition as the standard into the equipment and result was obtained from the equipment screen.

IRON

248.3nm wavelength was selected Air and gas flow was adjusted slit width and other vital setting as was recommended for the instrument was adjusted hollow cathod lamp was stabilized and allow adequate time to energized. Then, the instrument was calibrated with standard Iron ion concentration to obtain a standard plot. The sample was aspirated into the instrument and concentration of Fe ion in sample was obtain by extrapolation from standard Iron ion graph in ppm mg/L

MANGANESE

279.5nm wavelength was selected Air and gas pressure was adjusted, slit width and other vital settings recommended for the instrument employed were programmed and regulated. Then equipment was calibrated by aspirating standard manganese ion concentrations, standard graph of manganese was plotted, then sample solution was aspirated into the AAS chamber. The concentration of Mn ion in the sample was determined from the standard Mn ion graph in mg/L.

ZINC

213. 8nm wavelength was selected; air gas pressure flows were adjusted. Slit width and other setting as was recommended were adjusted. Hollow cathode lamp was allowed to stabilize. The standard zinc concentrations was aspirated to calibrate the equipment and to obtain standard graph of zinc ion. Aspirator system was flushed with de – ionized water occasionally before sample solution was aspirated and the concentration of zinc ion in the sample was extrapolated and recorded in mg/L or ppm.

CUPPER

324.8nm wavelength was selected Air and gas pressure was adjusted. Slit width and other setting as recommended for the instrument was adjusted. Hollow cathode lamp was energized and adequately allows stabilizing copper ion concentration and graph of same were plotted. Then the sample solution was aspirated into equipment and the concentration in the same was extrapolated from the standard copper graph in ppm or mg/L.

LEAD

Sample was converted to ash in a Muffle furnace at a temperature of 630^0C for 3hours. The ash was dissolved in 10ml of conc. hydrochloric acid and was heated on an electro-thermal heater hot plate. The solution of the ash was diluted to 50mls with distilled water the solution was analyzed for metal ion by AAS. Lead ion was analyzed by AAS at 283.3nm wavelength. The wavelength selected with a narrow slit width, air and acetylene gas flow was adjusted and other setting as recommended for the instrument employed was attended to and regulated. Hollow lamp cathode was given adequate time to stabilized before aspirating standards solution for equipment calibration. After calibrating the equipment with standard lead concentration the system was flushed with distilled water severally before aspirating the samples solution on the sample experimental condition used for the standard. The concentration of lead ion in the sample was extrapolated from the standard graph of lead ion plotted.

RESULTS

Rizopus stolonifer and *Bisporus sp* were isolated from the infected fruits of *Dacryodes edulis*, and the result of the pathogenicity test showed that the two fungi were implicated in the post-harvest soft rot of the fruits, *R stolonifer*, being more pathogenic.

Table 1, shows the proximate composition of infected and apparently healthy fruits of *Dacryodes edulis.* Fibre and Ash composition is relatively higher in the infected fruit than apparently healthy fruits. Moisture, lipid protein and carbohydrate composition of apparently healthy fruits were higher than that of infected fruit. However, the correlation test carried out showed that there was no significant difference between the result of the infected and apparently healthy.

Table 2, shows the result of analysis of infected and apparently healthy fruits of *Dacryodes edulis*. Alkaloid, flavonoid and saponin in apparently healthy fruits were higher than percentage composition of non infected fruit, while cynogenic glucoside and tannin concentration were the same in the infected and apparently healthy fruit. Correlation test carried out showed that there was no significant difference between the result of the infected and apparently healthy fruits.

Table (3), shows the result of metallic, non-metallic and vitamin composition in infected and apparently healthy fruits *Dacoryode edulis.* Sodium, potassium, Zinc, potassium and lead concentration of apparently healthy fruits were higher than those of infected fruits and magnesium, calcium, manganese and cupper in apparently healthy fruits were greater than those in the infected. Iron was not detected. Correlation test carried out showed that there was no significant difference between infected and apparently healthy fruits. Result of anion composition in infected and apparently healthy fruits of *D. edulis*. Showed that phosphorous and itrate composition of infected fruit were greater than concentration apparently healthy fruits. Nitrogen concentrations in apparently healthy fruits were greater than those in infected fruits. Statistically there was no significant difference between the apparently healthy and the infected.

DISCUSSION

Rhizopus stolonifer and *Bisporus sp* were isolated from the infected fruits of *Dacryodes edulis*, and the result of the pathogenicity test showed that the two fungi were implicated in the post harvest soft rot of the fruits, *R. stolonifer*, being more pathogenic.

Results of investigation of the proximate composition of the infected and the apparently healthy fruits of *Dacryodes edulis* (Table 1). Showed that there was a decrease in the lipid, carbohydrate and moisture contents of the infected fruits, while the ash, protein and fibre contents of the infected fruits were relatively higher. The decrease in the lipid and carbohydrates contents of the infected fruits could be due to the disintegration of the polysaccharides into smaller molecules which was then utilized or absorbed by the fungi. More so, the decrease in the moisture content of the apparently healthy fruit might be attributed to the utilization of the moisture by the fungi for their various metabolic activities, thus leading to the dry rot of the fruit.

The relative increase in the protein and fibre contents of the infected fruits might be caused by some experimental errors in the determination of the protein and fibre contents of the fruit.

Vitamin C contents of the infected fruits were observed to be higher when compared with the apparently healthy fruits. This however, differs from the report of the Lunn (1977) that fungi require a source of nitrogen and organic groups such as vitamins.

It was also observed that the Na, K, Mg, Zn, P, Pb, and Nitrate contents of the infected fruits studied were relatively higher than those of apparently healthy fruits. In the healthy fruits in apparently fruits there was increase in the Mg, Ca, Cu and Nitrogen (Table 3).

The digestion, degradation and conversion of the biochemical complexes of the fruit by the fungi into inorganic ions could be responsible for the increase in the Na, K, Mn, Zn, P, Pb and Nitrates content of the infected fruits relative to the apparently healthy fruits. This could also be responsible for the relative increase in the ash contents of the infected fruits observed in this study. Although there was a decrease in some of the mineral content of the infected fruits, the released minerals from the conversion of the biochemical complexes of the fruit into inorganic ions might have been utilized by the fungi for growth. Lunn *et al*, (1986) , reported that fungi are heterotrophic,(require an organic source of carbon), and also require a source of nitrogen, usually organic such as amino acid, carbohydrate and in organic ion such as K^+ and Mg^+ trace element such as Fe, Zn and Cu and organic group such as vitamin. Carbohydrate and protein are extra-cellularly digested by enzymes called carbohydrase and protease into glucose and amino acid respectively; and glucose is used during respiration to provide energy for the organisms or pathogen's metabolic activities, and amino acid for growth and repair by fungi (Gatumbi, 1990). Potassium (K) mainly associated with the functions fungal membrane, maintaining electrical potential across membranes, anino / cation and osmotic balance. The report of Palomer, (1980), stated that fungi use magnesium as co-factor for many enzymes, and that fungi require a source of nitrogen usually organic and also inorganic ion such as Mg^{2+} is in line with the present investigation. Iron contributes to oxygen and electron carrying in the course of respiration, and Zinc help in anaerobic respiration of fungi, which could be seen in alcoholic fermentation. Cupper plays a crucial role in electron carrier in respiratory chain-oxygen converted to water in fungi (Palomer, 1980). Use up of some of these nutrients deprives man of the necessary nutrients derived from the fruits.

Table 1. Proximate Composition of Infected and Apparently Healthy Fruits of *Dacryodes edulis.*

S/N	PROXIMATE COMPOSITION	FIFDE	AHFDE
1	Moisture (%)	31. 67 ± 0.44	51. 35 ± 0.30
2	Ash (%)	2. 37 ± 0.04	0. 79 ± 0.01
3	Lipid (%)	31. 70 ± 0.00	33. 46 ± 0.00
4	Carbohydrate (%)	4. 32 ± 0.00	8. 60 ± 0.00
5	Protein (%)	4. 33 ± 0.04	2. 18 ± 0.01
6	Fibre	25. 41 ± 0. 29 (P>0.5)	3. 45 ± 0.36

FIFDE: Fungi infected fruit of *Dacryodes edulis* **AHFDE:** Apparently fruit of *Dacryodes edulis*

Table 2. Phytochemical Composition of Infected and Apparently Healthy Fruit of Dacryodes.

S/N	PHYTOCHEMICAL COMPOSITION	FIFDE	AHFDE
1	Akaloid (%)	3. 17 ± 0.12	13. 17 ± 0.15
2	Flavonoid (%)	2. 67 ± 0.01	3. 65 ± 0.02
3	Saponin (%)	17. 03 ± 0.08	15. 03 ± 0.03
4	Cynogenic glucose	0.002 ± 0.00	0. 002 ± 0.00
5	Tanin (%)	0. 05 ± 0.00	0. 05 ± 0.00
		(P>0.05)	

FIFDE: Fungi infected fruit of *Dacryodes edulis*; **AHFDE:** Apparently fruit of *Dacryodes edulis*

Table 3. Metallic (Cation), Non-Metallic and Vitamin Composition of Infected Apparently Healthy of *Dacryodes Edulis.*

	METAL COMPOSITION	FIFDE (mg/kg)	AHDE (mg/g)
1	Sodium (Na)	340.77 ± 0.12	246.83 ± 0.03
2	Potassium (K)	258.1713 ± 0.31	86.4213 ± 0.03
3	Magnesium (Mg)	189.10 ± 0.05	249.43 ± 0.03
4	Calcium (Ca)	2.77 ± 0.10	82.83 ± 0.05
5	Iron (Fe)	N.D	N.D
6	Manganese (Mn)	-6.04 ± 0.025	-5.90 ± 0.08
7	Zinc (Zn)	2.60 ± 0.17	1.80 ± 0.00
8	Cupper (Cu)	-0.64 ± 0.03	1.80 ± 0.05
9	Lead (Pb)	16.40 ± 0.25	15.03 ± 0.03
10	Nitrogen	0.0077 ± 0.001	0.034 ± 0.001
11	Phosphorous	107.1 ± 2.19	510.25 ± 0.39
12	Nitrate	444.478 ± 13.90	339.7 ± 421.4
13	Vitamin C	235. 85	141. 34
		(P>0.05)	

FIFDE: Fungi infected fruit of *Dacryodes edulis*.,AHDFE: Apparently healthy fruits of *Dacryodes edulis*. ND= not detected

The alkaloid and flavonoid contents of the apparently healthy fruits were relatively higher, while the saponin contents of the non-infected fruits were lower. The contents of cyanogenic glycosides and tannin in both the infected and apparently healthy fruits were the same (Table 2).

It could be suggested that the relatively high levels of alkaloids and flavenoids in the apparently healthy fruits could be responsible for the healthy state of the fruits. The infected fruits might have produced saponins as a part of the active defensive mechanism against the attack of some fungal species, hence, the reason for their relatively high levels in the infected fruits examined. According to Akwaowo *et al* (2000), high intake of tannins has been associated with carcinogenic effect in man, poor protein utilization liver and kidney toxicity. Lunn *et al* (1986), however, reported that the levels of anti-nutrients in the fruits of *D. edulis* do not reach lethal dosages. Consumers should, however, stick to processed or cooked African pear and not raw as most of these toxicants could be eliminated during cooking or processing. They are also encouraged to eat the fruit as soon as they are plucked to prevent spoilage by fungi .The presence of cu, pb, and zn in the plant shows that the plant could play a role in phytoremediation.

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Corresponding author: Dr. O. F. A. Ibiam, Department of Applied Biology, Ebonyi State University, Abakaliki, Nigeria **Email:** drakanuibiamjr@yahoo.com