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Research Article

# Potential of cassava peel collected from Bauchi (Nigeria) as culture media for growing specific fungi

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**Abstract**. The objective of this paper is to assess the potential of using cassava peel for *A. niger* and *penicillium* growth using standard methods and chemicals of analytical grade. The result of the study indicates that, the peel is rich in proximate contents as the analyzed cassava peel is composed of 8.70% moisture, 4.89% crude protein, 6.9.00% carbohydrates, 4.00 % fat content, 8.93% ash, and 8.75% fibre. Considering the observed morphological and physical characteristics of the test fungi; therewith, *A. niger*, and *penicillium* were present. There is indication that, the two utilized media (control and formulated media) are in support of the two microbes growth and depicted positive results of degradation, as well as fermentation ability on the cassava peels. The enriched cassava agar supports higher growth of the two analyzed microbes (viz, *A. niger*, and *penicillium*). There was significant difference pertaining the colonies number made on the formulated media (cassava peel agar, and enriched cassava agar). Potato dextrose agar (PDA) shows lower colony count amounting to 3.4 0.1 CFU/ml for *A. niger*, and amounting to 3.3 0.2 CFU/ml for *penicillium*. Cassava peel agar (CPA) possessed 6.5 0.5 CFU/ml mean colony count (MCC) for *A. niger*, and 5.6 0.1 CFU/ml for *penicillium*. Enriched cassava agar media (ECA) had highest MCC as 7.8 0.1 CFU/ml with respect to *A. niger*, and 7.3 0.6 CFU/ml pertaining *penicillium*. Utilization of cassava peel as substrate due to its contents of nutrients that can meet the nutritional requirement of fungi growth is a better move. The peel may be considered as substitute and alternative substrate for producing culture media to cultivate fungi and consequently reducing pollution.

**Keywords:** *A. niger*, cassava, peel, culture media



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## 1. Introduction

Cassava is a good source of nutrition and livelihood for about 500 million or more people including traders, processors, and consumers around the globe. It is a good staple food material providing carbohydrate, and can easily be utilized as raw material for making processed food materials, and many industries use cassava for other industrial applications as well (Aro et al., 2010; Verma et al., 2022). Cassava is a starch containing root vegetable botanically called *Manihot esculenta*, a tuber crop similar to yam and potatoes. Many people consume cassava as in raw, cooked, and processed forms. In fact, cassava is the third most significant source providing carbohydrate in the tropics and related regions after maize and rice yielding 60 % or more energy needed by Africans, as well as Central American people. In semi-arid areas of Africa, cassava is the second most predominant staple food material. Cassava is a crop that has the adaptability to diverse areas despite their harsh climates (Lindquist, 2006; Afolabi et al., 2012).

Nutritionally speaking, cassava is a better source of carbohydrates; and contains low protein of the root, low fat, significant moisture, significant starch, sugar moieties, significant Fe, and vitamin A among others (Jackson et al., 2014; Verma et al., 2022).

Nevertheless, animal feeds are made from cassava products; cassava has been used in food industries such as bread making, biscuits making, etc (Jackson *et al.,* 2014; marti, 2015). However, there is a concern about some of the contents of cassava, because all its organs possessed cyanogenic glucosides, the famous antinutrients that make hydrogen cyanide (a toxic compound) (Akinpelu et al., 2011). Additionally, cassava peels are significantly released at the end of all processes leading to cassava usage (Velmerugu, 2014; Williams et al., 2021); but, the peel is containing elevated amount of cyanide, a toxic, and polluting material of discomfort (Williams *et al*., 2021). The peels can also cause environmental degradation, due to the presence of cyanogenic glucosides, lotaustrain, linamarin that upon natural processing give out hydrogen cyanide, a highly potent poisonous material that may elicit nausea, dizziness, vomiting, paralysis, and diarrhea (Nwajuba, 1990; Obadina *et al*., 2011; Williams *et al.,* 2021).

During cassava usage or processing, the cassava peel waste is becoming an enigma due to its hugeness, toxicity, and slow biodegrading (Itelima et al., 2014; Williams et al., 2021). The growing industrial processing of cassava will definitely increase a concern for management of cassava peel waste (Obadina et al., 2011; Akpabio et al., 2012). Therefore, it is important to seek for better ways of managing cassava peel waste. Due to carbohydrate and related contents of cassava there is potential for use in fungi growth media (Ryan & Ray, 2004;

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Obadina et al., 2011). The objective of this paper is to determine the potential of using cassava peel for *A. niger* and *penicillium* growth.

## 2. Material and method

### *2.1. Study Area*

The study area was carried out in Bauchi, Bauchi state which is located in the Northern part of Nigeria with coordinates of Latitude 100 18' 37.15'' N and Longitude 90 50' 37.97'' E and it covers 45,837 square kilometers. The state is bordered by Kano and Jigawa to the North, Yobe and Gombe to the east and Kaduna to the west and Plateau to the south.

### *2.2. Sterilization of Glass Ware*

All glass wares are washed, dried and sterilized (using dry heat sterilization) in hot air oven at 1600C for 1hours while wire loop was sterilized by flaming to red hot using naked flame. The working surface was disinfected with 70% ethanol Barnett et al. (2009).

### *2.3. Collection and Processing of sample*

Cassava peels were collected from the Kariya District in Ganjuwa Local Government Area, Bauchi state in a cleaned polythene bag and transported to Ali Tatari Polytechnic Bauchi Science Laboratory Technology Department laboratory. After selection, the biomass was pre-washed with running tap water to remove the sticky impurities followed by chopping into small pieces by manually or mechanical cutter (Braide et al., 2016) and dried to reduce the moisture content of sample to 10 ± 1% before milling (Marti tutt, 2015). Then ground the pieces into powder form (2mm size particle) using a mortar and pestle, the powder was stored for further analysis (Barnett et al. (2009).

### *2.4. Collection of Test Organisms*

The test organisms that were used are *Aspergillus niger* and *Penicillium* species which were locally isolated from spoilt bread and soil sample. Subsequent culturing was carried out until a pure culture of the microorganisms was obtained and maintain on potato dextrose agar (PDA) plate (Arulanantham et al., 2012).

### *2.5. Formulation and composition of medium*

About 0.23+0.02g of Agar/agar, 2+0.2g of ground cassava peel was respectively weighed and dissolved in 40ml of water and sterilized at 1210C for 1 5 minutes in autoclave and allowed to cool below $45^0$C, approximately 20ml of the molten medium was transferred into 2 sterile Petri dishes and allowed to solidify before inoculation (Barnett et al., 2009).

### *2.6. Enrichment of Formulated Media*

Meat infusion was used to enrich the media. The meat sample was purchased from Muda Lawal market and washed properly, the meat was cooked for 15-30 minutes, 1ml of the broth or infusion was aseptically injected into the cold molten formulated CPA medium, and about 20ml of the molten medium was transferred to 2 sterile petri dishes and allowed to solidify (Arulanantham et al., 2012).

### *2.7. Microbial Inoculation*

*Aspergillus niger* and *Penicillium* species were inoculated into the formulated media, which are cassava peels Agar (CPA) and the enriched cassava peels media (ECPA) using wire loop after been flamed. The plates were aerobically incubated in an incubator at 370C for 3-11 days. And for comparative analysis, a conventional mycological media (PDA) was prepared according to manufacturer's specification and used as control (Barnett et al., 2009).

### *2.8. Characterization and Identification of Fungal Culture*

Parameters such as morphology and cultural characteristics, size, and generation time were observed and recorded. The fungal isolates were identified by making reference to Barnett et al. (2009).

## 3. Results

The results obtained in this study are displayed in Tables1-4.

Table 1. Proximate analysis results of cassava peel utilized in this study

| Component | Dry weight (%) |
|---|---|
| Crude protein | 4.89 |
| Fat content | 4.00 |
| Fibre content | 8.75 |
| Ash content | 8.93 |
| Moisture | 8.70 |
| Carbohydrate content | 69.00 |

Table 1 shows the analyzed cassava peel is composed of 8.70% moisture, 4.89 crude protein, 6.9.00 carbohydrates, 4.00 % fat content, 8.93% ash, and 8.75% fibre.

**Table 2**. Physical and morphological characteristics of test fungi

| Media | Test organism | Colour of colony | Shape of colony | Size of colony |
|---|---|---|---|---|
| CPA (Cassava peel agar) | *A. niger* | Black | Round | Big |
| | *Penicillium* | Greenish | Irregular | Big |
| ECPA (Potato dextrose agar) | *A. niger* | Black | Round | Small |
| | *Penicillium* | Greenish | Irregular | Small |
| PDA (Enriched cassava agar) | *A. niger* | Black | Round | Big |
| | *Penicillium* | Greenish | Irregular | Big |

Table 2 shows the morphological and physical characteristics of the test fungi; therewith, *A. niger*, and *Penicillium* were suspected to be present; and it indicates that the two utilized media (control and formulated media) are in support of the two microbes growth.

Table 3. Generation time of test fungi

| Media | Test organism | Colour of colony |
|---|---|---|
| CPA (Cassava peel agar) | *A. niger* | 1-10 days |
| | *Penicillium* | 1-9 days |
| ECPA (Potato dextrose agar) | *A. niger* | 1-11 days |
| | *Penicillium* | 1-11 days |
| PDA (Enriched cassava agar) | *A. niger* | 1-9 days |
| | *Penicillium* | 1-9 days |

Table 3 shows the enriched cassava agar supports higher growth of the two analyzed microbes (Viz, *A. niger*, and *Penicillium*).

Table 4. Mean colony on the formulated media and potatoes dextrose

| Medium | Mean colony count (CFU/ml) | |
|---|---|---|
| | *A. niger* | *Penicillium* |
| CPA (Cassava peel agar) | 6.5 ± 0.5 | *5.6* ± 0.1 |
| ECPA (Potato dextrose agar) | 3.4 ± 0.1 | 3.2 ± 0.02 |
| PDA (Enriched cassava agar) | 7.8 ± 0.1 | 7.3 ± 0.06 |

In Table 4, there was significant difference pertaining the colonies number made on the formulated media (cassava peel agar, and enriched cassava agar).

## 4. Discussion

Cassava peel is a major waste during cassava processing and is of concern due to its larger quantity, toxicity, low degradation, and lack of technical know-how to process it among local farmers (Ebah et al., 2021; Sarkingobir et al., 2023; Umar et al., 2023). It is therefore dutiful to use biotechnological means to ease this concern. Parable, fungi have been related elsewhere to contain enzymes that degrade cassava peel contents and elicit changes, especially hastening of degradation or biotransformation to harmless entity (Ryan & Ray, 2004; Ebah et al., 2021). And on the other hand cassava peel could lend a great opportunity for providing media for microbial growth, despite of the current challenges (such as that of expensive media) facing laboratories in our setting (Akinpelu et al., 2011; Velmurugu, 2014). Then, this work assessed the potential of cassava peel for fungi growth and biodegradation.

Nevertheless, for the peel to support growth of nay biological it has to contain nutrients (Sarkingobir et al., 2023; Umar et al., 2023). Therewith, Table 1 shows the proximate compositions of cassava peel, including the levels of moisture, crude protein, carbohydrate, ash, fat, and fibre content. This indicates that, the peel is rich in macromolecules required by biological systems (animals, humans, and microbes); and it suggest the potentiality of the peel media for microbial growth or microbial degradation (Verma et al., 2022). The ash, % crude fat, in this work are higher than values reported in different peels in Ibadan by Williams et al., (2021). Albeit, fibre is lower than that of Williams et al., (2021); carbohydrates, fibre, fat, proteins in cassava root reported by Verma et al., (2022) were lower than this work.

Table 2 shows the morphological and physical characteristics of the test fungi; therewith, *A. niger*, and *Penicillium* were suspected to be present; and it indicates that the two utilized media (control and formulated media) are in support of the two microbes growth. In tandem with the results in Table 2, the cassava peel observes by Ebah et al., (2021) was reported of supporting Aspergillus species in Makurdi study. Likewise, Akinruli et al., (2022) in their study of cassava peels for bioethanol production indicates that, *Aspergillus niger* express positive results of degradation, as well as fermentation ability on the cassava peels. The ability of microbes to degrade cassava peels was conferred upon the them because they acquire specific groups of catabolic enzymes (Akinruli et al., 2022).

Table 3 shows the enriched cassava agar supports higher growth of the two analyzed microbes (Viz, *A. niger*, and *Penicillium*). This indicates the possibility of enriching microbial media with the cassava peel, a finding that was similarly corroborated to high proteinous and carbohydrate compositions of the cassava peel and could suggest the tip for utilization of the cassava peel for other possible value added products (Obadina et al., 2011).

Meanwhile, in Table 4, there was significant difference pertaining the colonies number made on the formulated media (cassava peel agar, and enriched cassava agar); whereby, potato dextrose agar (PDA) shows lower colony count amounting to 3.4 0.1 CFU/ml for *A.niger*, and amounting to 3.3 0.2 CFU/ml for *Penicillium*. Secondly, cassava peel agar (CPA) possessed 6.5 0.5 CFU/ml mean colony count (MCC) for *A. niger*, and 5.6 0.1 CFU/ml for *Penicillium*. On the other hand, enriched cassava agar media (ECA) had highest MCC as 7.8 0.1 CFU/ml with respect to *A. niger*, and 7.3 0.6 CFU/ml pertaining *Penicillium*.

## 5. Conclusion

Certainly, the use of cassava peel to support the growth of fungi was assessed in this work and it was demonstrated that, cassava peel contains nutrients that augment the growth of specific fungi microbes. Thus, utilization of cassava peel as substrate due to its contents of nutrients and minerals that can meet the nutritional requirement of fungi growth is a good idea, and this put cassava peel a better substitute and alternative substrate for producing culture media to cultivate fungi and consequently reducing pollution. Cassava peel is additionally a renewable and sustainable material that when used, the processing of the biomass materials substitutes the synthetic and commercial media, and on the other hand yielding a natural media that is attractive, a media with potential of accelerating sustainable use of resources and change the global economy toward a greener future.

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