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Studies on the Proximate Contents and Potentials of *Musa sapientum* and *Persea americana* Fruits Peel as Media for the Growth of Medically Important Fungi

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Authors' contributions

This work was carried out in collaboration among all authors. Author DCE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors OCE and EAE managed the analyses of the study. Author OCE managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The present study was designed to formulate growth media for medically important fungi using banana and avocado fruits peel.
Methodology: The peels were obtained from fresh banana and avocado fruits and dried into crisps at 100^{o}C using hot air oven, pulverised into powder using Hammer mill machine and sieved into fine powder using 1 mm sieve size. Pure isolates of *Aspergillus flavus, Aspergillus fumigatus* and *Cladosporium* sp. were obtained from the Diagnostic Laboratory of the Department of Microbiology, University of Nigeria, Nsukka and used for the study. Two different media, Banana Peel Agar (BPA) and Avocado Peel Agar (APA) were formulated. 2 g of each fruit peel powder was introduced into separate conical flasks, 1g of agar powder was added as solidifying agent and varied glucose concentrations (20%, 10%, 5% and 0%) was used as nutrient (carbon source) supplement. The prepared media was sterilized by autoclaving at 121°C for 15 minutes. The test organisms were

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inoculated aseptically onto the formulated media and incubated for 3 days at 37^{o}C. Fungal growth was visually observed. For comparative analysis, Sabouraud dextrose agar (SDA) was used as control.

Results: The formulated media supported the growth of all the test organisms, although at varying degrees. BPA showed more suitability than APA, with the growth of the test organisms on BPA favourably comparable to that on SDA. Proximate analysis of the fruit peels indicated that the moisture, ash, fat, crude fibre, crude protein and carbohydrate contents of avocado peel were 7.35%, 14.65%, 0.10%, 9.75%, 6.57% and 61.58% respectively and 5.80%, 6.00%, 0.45%, 5.35%, 10.95% and 71.45% respectively for banana peel.

Conclusion: Banana and avocado fruits peel can be utilized as alternative materials in the formulation of culture media for the *in vitro* cultivation of fungi for medical and research purposes.

Keywords: Fruit peels; fungi; Aspergillus flavus; Aspergillus fumigatus; Cladosporium sp.

1. INTRODUCTION

All over the world, efficient agricultural practices give rise to large production of fruits [1]. Banana, pineapple, mango, avocado pear and orange are among the most widely accepted fruits [2]. Waste arising from the aforementioned fruits includes peels, pulp and seeds. These constitute about 40% of the total mass. The majority of these wastes are often not properly disposed and they constitute huge environmental pollution [3]. Environments dumped with fruit peels provide a good site for the proliferation of microorganisms including (pathogenic) fungi. An alternative to fruit waste disposal is incineration and landfill. However, these methods result in significant problems of concern as they generate gases that pollute the air as well as massive substances that leach into ground water or even surface water, destroying aquatic lives [4] thus contributing to the existing environmental problems. This problem can be partly addressed by exploiting these fruit peels for the production of value-added products, including microbiological media [1].

Sabouraud dextrose agar (SDA) and Potato dextrose agar (PDA) are commonly used as general purpose media for the growth of a broad range of fungi. Fungi are a group of eukaryotic spore-bearing microorganisms that generally reproduce both asexually and sexually [5]. While some play roles in the recycling of nutrients in the environment, some are agents of diseases to man (i.e. pathogenic). These ready-made PDA and SDA conventionally used for culturing fungi are relatively expensive for routine microbiological studies in schools especially those in resource-poor countries of the world. Microbiological researches are done at high cost occasioned by scarcity of culture media, other reagents and facilities. This is one of the problems of research in developing countries [6]. Routine microbiological experiments require large amounts of media. The search for alternative and affordable media for use in the laboratory is trending.

Recent researches have been geared towards finding alternatives to the present list of available mycological media in general. Fruits peel wastes has been considered as an alternative for formulation of mycological media [1]. Fruit peel wastes are materials that have not been fully utilized. They are materials left over after production and consumption of the fruits [7]. Fruit peel wastes are part of the unavoidable result of human activities [8]. Fruit peel wastes contain simple and complex sugars which are easily metabolized by microorganism, especially fungi [9].

Fungal growths are commonly observed on banana and avocado pear peels, suggesting potentials for these substances as mycological media. The peels are usually available locally both during season and off season. These facts gave impetus to this research. The work was designed to create value for what are otherwise environmental hazards and in doing so, solve a research problem.

2. MATERIALS AND METHODS

2.1 Collection of Fruit Peels

Fruits peel used in this study were collected from healthy and fresh banana and avocado pear fruits bought from fruit vendors at Ogige Market in Nsukka, Enugu State, Nigeria. Nsukka is a town within Nsukka Local Government Area of Enugu State in southeast Nigeria. The town is

within Latitude 6°51°N and 7°00°N of the Equator and Longitude 7°23°E and 7°45°E of the Greenwich Meridian on an elevation of 1,810 ft (552 m) [10].

2.2 Treatment of Sample

The fruits collected were transported immediately to the Laboratory where they were peeled. The peels were washed and chopped into small pieces and rinsed severally with clean water. Banana peels were dried using hot air oven at 100°C for 5 days while avocado pear peels were dried for 2 days at 100°C using same hot air oven. The dried peels was pulverised using Hammer mill machine and sieved into fine powder using 1mm sieve size. The resulting powder was packaged in an airtight container and stored in a cool dry place until use.

2.3 Formulation of Media

Media formulation followed, with major modifications on nutrient concentrations, the methods of [11]. Banana Peel Agar (BPA) and Avocado Peel Agar (APA) were formulated as follows: 2g of each fruit peel powder was introduced into separate 250 ml conical flask. 1gram of agar powder was added as solidifying agent and varied glucose concentrations of 20%, 10%, 5% and 0% were separately added as nutrient (carbon source) supplement. Distilled water was added to make each medium up to 100ml. Each flask was well shaken to obtain a homogenous mixture and subsequently sterilized by autoclaving at 121°C for 15 minutes. After autoclaving, the dissolved media was allowed to cool before pouring out into separate Petri dishes. For comparative analysis, a conventional mycological media (SDA) was prepared according to manufacturer's specification and used as control.

2.4 Test Organisms

The test fungal organisms used in this study, *Aspergillus flavus, Aspergillus fumigatus* and *Cladosporium* sp. were pure isolates obtained from the Diagnostic Laboratory of the Department of Microbiology, University of Nigeria, Nsukka.

2.5 Inoculation of Test Organisms into Formulated Media

The suitability of the formulated media was determined by culturing the test organisms on them. A loopful of actively growing pure cultures of each of the test organism was aseptically inoculated onto each of the formulated medium and incubated at 37°C for 72 hours. The test organisms were also inoculated onto the SDA control plates. At the end of the incubation period, the extent of spore growth on the different media formulations was compared.

2.6 Proximate Analysis

The proximate analysis of the banana and avocado fruits peel was carried out at the Department of Crop Science Laboratory, University of Nigeria, Nsukka, to determine the moisture, ash, fat, crude protein, fibre and carbohydrate content of the fruit peels. The moisture content was determined using oven method [10]. Muffle furnace method [12] was used to determine the ash content. The fat content was determined using Soxhlet apparatus [12]. The crude protein content was determined by the micro Kjedahl method [10]. The crude fibre and carbohydrate contents were determined using the official methods of analysis of AOAC [13].

3. RESULTS

3.1 Quantitative Growth of Test Organisms on APA and BPA

The formulated media was inoculated with the test organisms and incubated for three days after which the growth was analyzed and compared with that on the control plate (SDA). The result showed that both media formulations supported the growth of the test organisms irrespective of the concentration of glucose supplement, although at varying degrees. BPA showed more suitability for the growth of the test organisms than APA as the growth of the test organisms on BPA was highly comparable to that on SDA.

3.2 Effect of Glucose Concentration on Fungal Growth

The effect of varied glucose concentration on the media formulation on the growth of the test organisms was studied. Growth was observed on all the media formulations including the formulation which had no glucose supplement. Addition of glucose had no marked effect on the growth of *Cladosporium* sp., *Aspergillus flavus, and Aspergillus fumigatus* on the formulated BPA since similar growth was observed on all the formulations. However, for APA, more growth of

Cladosporium sp., *Aspergillus flavus and Aspergillus fumigatus* was observed on the media formulation without glucose supplement.

3.3 Proximate Composition of Avocado and Banana Peels

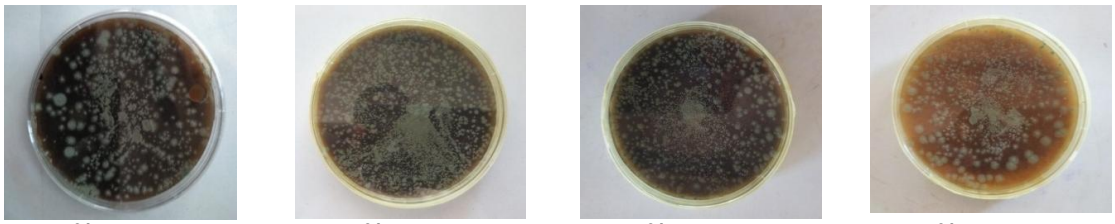
Avocado peel had higher percentage moisture, ash, and crude fibre contents (7.35%, 14.65%, 9.75% respectively) than banana peel (5.80%, 6.00%, 5.35% respectively). Banana peel on the other hand had more fat, protein and carbohydrate contents (0.45%, 10.95%, 71.45% respectively) than avocado peel (0.10%, 6.57%, 61.58%).

4. DISCUSSION

The aim of the study was to determine the suitability of banana and avocado fruit peels for the cultivation of medically important fungi. Previously, [1,11,14-17] reported the use of alternative culture media for growing fungi.

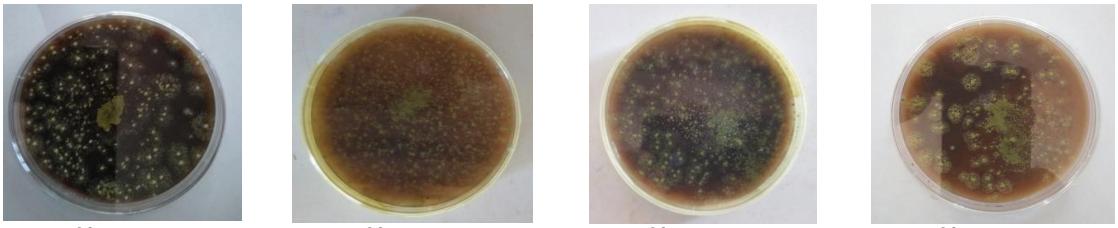
Table 1. Proximate composition of avocado and banana peels

Peel	Moisture (%)	Ash (%)	Fat (%)	Fibre (%)	Protein (%)	Carbohydrate (%)
Avocado	7.35	14.65	0.10	9.75	6.57	61.58
Banana	5.80	6.00	0.45	5.35	10.95	71.45



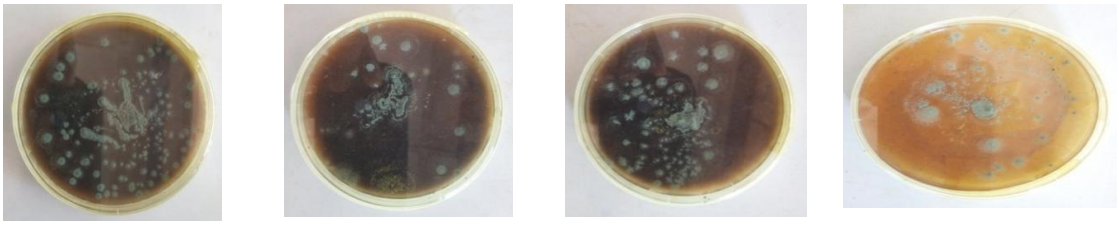
20% glucose **10% glucose** **5% glucose** **0% glucose**

Fig. 1. Growth of *Cladosporium* sp. on banana peel agar



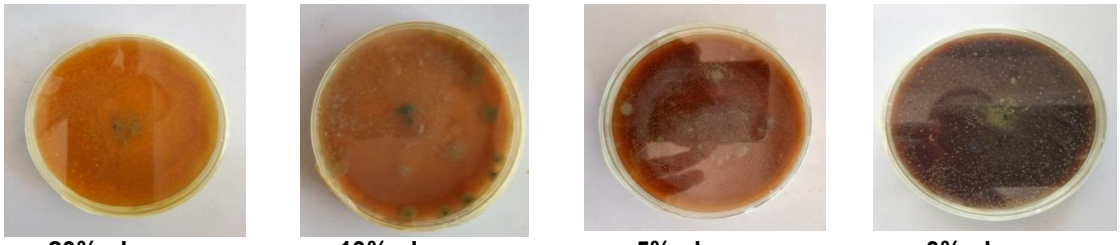
20% glucose **10% glucose** **5% glucose** **0% glucose**

Fig. 2. Growth of *Aspergillus flavus* on banana peel agar



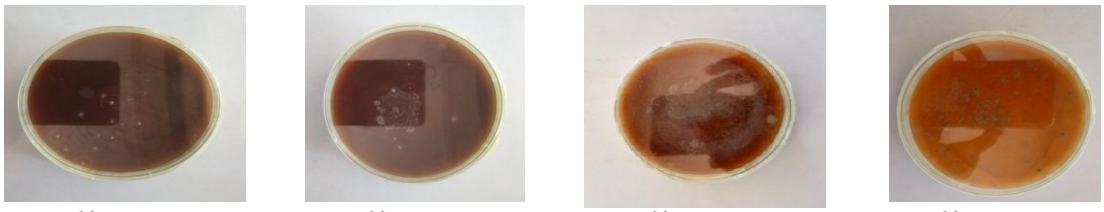
20% glucose **10% glucose** **5% glucose** **0% glucose**

Fig. 3. Growth of *Aspergillus fumigatus* on banana peel agar



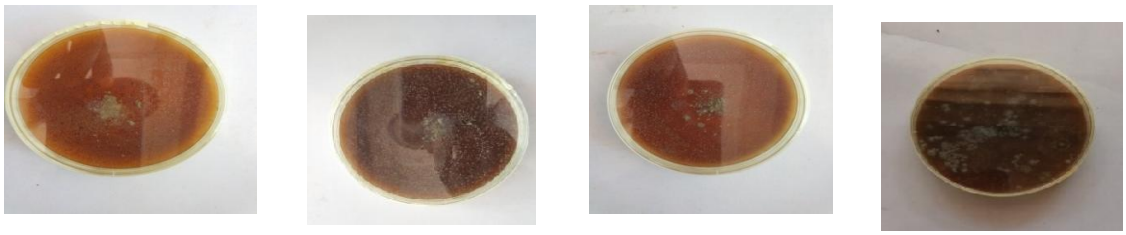
20% glucose **10% glucose** **5% glucose** **0% glucose**

Fig. 4. Growth of *Aspergillus flavus* on avocado peel agar



20% glucose **10% glucose** **5% glucose** **0% glucose**

Fig. 5. Growth of *Aspergillus fumigatus* on avocado peel agar



20% glucose **10% glucose** **5% glucose** **0% glucose**

Fig. 6. Growth of *Cladosporium* sp. on avocado peel agar

The results of the present study revealed that media formulated with banana and avocado fruits peel supported the growth of all the test fungi irrespective of the concentration of the glucose supplement, though, at varying degrees. The growth of the fungi on the formulated media implies that the peels used in formulating the media contained the required nutrients for fungal growth. Interestingly, the growth of the test organisms on the media formulation without glucose supplement indicates that the medium could be used for the cultivation of moulds without supplementing it with glucose and that the medium without glucose supplement provides optimum nutritional requirement for the growth of the moulds.

The values obtained from the proximate analysis are slightly different from those obtained by [15] showing proximate composition of protein = 10.44 ± 0.38; ash = 12.45 ± 0.38; carbohydrate = 43.40 ± 0.55 and fibre = 11.81 ± 0.06 for Banana peels. This led to variation in the concentration of the media components and also played a role in the overall outcome of the formulated media in good support of the growth of the test organisms. The differences in the proximate composition of APA and BPA must have led to variation in the concentration of the components of each of the medium. The nutrients present in the peels include protein, carbohydrate and appreciable minerals which are the essential requirements in a suitable fungi culture medium [16]. Protein constitutes a significant portion of microbial cells and thus is necessary for the growth of microorganisms. The protein content of the formulated media must have ensured a good supply of nitrogen while the carbohydrate content served as carbon source, both of which are essential for good fungal growth. The mineral content of the wastes in the formulated media was probably useful for some aspects of the fungi metabolism. Moisture (water) is required by all organisms for their life processes and fungi in

particular require water for extracellular digestion of nutrients.

5. CONCLUSION

The present study has revealed that banana and avocado fruits peel which are often regarded as wastes contain minerals and nutrients that can meet the nutritional requirements for the cultivation of medically important fungi. Thus, they can be utilized as alternative materials in the formulation of culture media for the *in vitro* cultivation of fungi for medical and research purposes. Although these peel powders can be prepared instantly, they can even be stored in air tight containers for about three months at room temperature in tropical climate. An important advantage of the fruit peels used in formulating the media is that it is readily available in Nsukka, Nigeria and cheap if at all they are to be purchased and may need no further enhancement with supplements to give maximum fungi growth. Using banana and avocado fruit peels for fungal cultivation media will help to reduce the amount of waste in the environment due to these plant products and avoid the problems associated with these wastes. With the interesting results obtained, it is highly recommended that researchers and students could make use of these fruit peels in media formulation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anbu S, Padma J, Punithavalli K, Saranraj, P. Fruits peel waste as a novel media for the growth of economically important Fungi. Int J Pharmacogn Phytochemi. 2017;6(6):426-428.
2. Jamal P, Tijani IDR, Alam M, Mirghani M. Optimization of cassava peel medium to an enriched animal feed by the white rot fungi Panustigrinus M609RQY. Int Food Res J. 2012;19(2):427-432.
3. Lim JY, Yoon HS, Kim KY, Kim KS, Noh JG, Song IG. Optimum conditions for the enzymatic hydrolysis of citron waste juice using response surface methodology (RSM). Food Sci Biotechnol. 2010;19(5): 1135-1142.
4. Ali SM, Pervaiz A, Afzal B, Hamid N, Yasmin A. Open dumping of municipal solid waste and its hazardous impacts on soil and vegetation diversity at waste dumping sites of Islamabad city. J King Saud Univ Sci. 2014;26(1):59-65.
5. Arat K, Suraj P, Mrunalini S, Kirti D, Jaspal KO, Jadhav P. Culture media formulation using fruit and vegetables waste. Int J Curr Res. 2017;9(9):568-587.
6. Jadhav P, Mrunalini S, Arati K, Suraj P, Kirti D, Jaspal K. Formulation of cost effective alternative bacterial culture media using fruit and vegetables waste. Int J Curr Res. 2018;10:2.
7. Janet I, Onyimba I, Ogbonna A, Nyam M, Nwaukwu I. Utilization of food crop wastes for the formulation of laboratory media used for cultivating soil fungi. Glob J Microbiol Res. 2014;2(1):112-116.
8. Okonkwo IO, Oiabode OP, Okeleji OS. The role of Biotechnology in the Socio-economic Advancement and National Development. Afr J Biotechnol. 2006;5 (19):2354-2366.
9. Saheed OK, Jamal P, Karim MIA, Alam Z, Muyibi SA. Cellulolytic fruits waste: a potential support for enzyme assisted protein production. J Biol Sci. 2013;13 (5):379-385.
10. Ali AN, Agbiogwu O. Poverty and socio-economic development in Nsukka Local Government Area, Enugu State, Southeastern Nigeria. Innovare J Social Sci. 2014;2(4):35 – 41.
11. Amadi OC, Moneke AN. Use of starch containing tubers for the formulation of culture media for fungal cultivation. Afr J Microbiol Res. 2012;6(21):4527-4532
12. Pearson D. Chemical Analysis of Foods. 7th Edition. Church hill Livingstone, Edinburgh; 1976.
13. AOAC. Official method of analysis, 16th Edition. Association of official analytical chemists. Washington D.C., USA; 1995.
14. Adesemoye AO, Adedire CO. Use of cereals as basal medium for the formulation of alternative culture medium for fungi. World J Microbiol Biotechnol. 2005;21:329-336.
15. Feumba DR, Ashwini RP, Ragu SM. Chemical Composition Of Some Selected Fruit Peels. Eur J Food Sci Technol. 2016;4(4):12-21.
16. Ruth AO, Gabriel A, Mirrila EB. Basal media formulation using Canavaliaensiformis as carbon and nitrogen source for the growth of some

fungi species. J Microbiol Biotechnol Food Sci. 2012;1(4):1136-1151.

17. Aigbogun EI, Mohammed SSD, Afangide CS, Luka FE, Kangla A. Tomato Juice Agar: An alternative media for the cultivation of some Aspergillus species. Int J Curr Microbiol Appl Sci. 2018;7(5):788-793.

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