

## Potential of cavendish banana peels as a fungal growth media



Endah Prayekti<sup>1\*</sup>, Hudan Dardiri<sup>1</sup>, Nur Aisyah<sup>1</sup>, Khoirun Nisya<sup>1</sup>

### ABSTRACT

**Introduction:** Banana peels are often discarded without further use. Whereas each banana peel contains nutrients that are quite high depending on the ripeness of the banana fruit. This has the potential to use banana peels as a medium for fungal growth. The purpose of this study was to determine the potential of banana peel as a growth medium for the test fungi, namely *Aspergillus fumigatus*, *Aspergillus flavus*, and *Candida albicans*.

**Method:** The type of research is experimental with variations in the mass of banana peels. The potency of banana peel media was evaluated by the growth of the test fungus which was expressed quantitatively by growth diameter and number of colonies. While the qualitative evaluation was carried out by observing the morphology of the test fungus colonies on banana peel media. The gold standard media used in this study were Sabouraud dextrose agar (SDA) for *Aspergillus*, and Potato dextrose agar (PDA) for *Candida*. Incubation for *Candida albicans* growth was carried out at 48 hours, while *Aspergillus* growth was incubated for up to 10 days. The data obtained were analyzed using Mann-Whitney.

**Result:** The results showed that the banana peel media could be overgrown with the test fungus. *Candida albicans* showed the best results in the 3% (w/v) variant, while *Aspergillus fumigatus* grew optimally at the 2% (w/v) variant. *Aspergillus flavus* was best at the 1% (w/v) variant.

**Conclusion:** Based on the results obtained, banana peels media can be used for the growth media of the tested fungi, and it is recommended to use the 2% (w/v) variant so that it can be used to grow all the tested fungi in this research.

**Keywords:** *Aspergillus fumigatus*, *Aspergillus flavus*, *Candida albicans*, Cavendish Banana peels, Growth media.

**Cite This Article:** Prayekti, E., Dardiri, H., Aisyah, N., Nisya, K. 2023. Potential of cavendish banana peels as a fungal growth media. *Bali Medical Journal* 12(3): 2778-2783. DOI: 10.15562/bmj.v12i3.4374

<sup>1</sup>Department of Medical Laboratory Technologies, Faculty of Health, Universitas Nahdlatul Ulama Surabaya, Indonesia.

\*Corresponding author:

Endah Prayekti;  
Department of Medical Laboratory Technologies, Faculty of Health, Universitas Nahdlatul Ulama Surabaya, Indonesia;  
endahphe@unusa.ac.id

Received: 2023-04-18

Accepted: 2023-08-30

Published: 2023-09-20

### INTRODUCTION

Banana peels are categorized as organic waste that is not utilized properly. As an organic waste, banana peels still have a high nutritional content. Proximate analysis per 100gr dry weight of banana peels showed a carbohydrate content of 68.31gr, mixed fat 10.44gr, mixed protein 7.57gr.<sup>1</sup> The high nutrient content can be used for growth media. Sources of vegetable materials from plants can be used as a medium for the growth of some fungi. However, evaluation is still needed in the use of banana peels for mushroom growth media.

Preparation of alternative media from vegetable materials has been carried out for mushroom growth media. Ganyong tubers are used as alternative media to replace potato dextrose agar<sup>2</sup>, bran can be used as alternative growth media for *Aspergillus sp*<sup>3</sup>, legumes can also be used as alternative growth media for *Aspergillus*.<sup>4</sup> Materials for making media can also be made from tofu dregs<sup>5,6</sup> or from vegetable

waste and onion peels.<sup>7,8</sup> Previously, the use of vegetable materials was mostly carried out on natural materials which were also used as food ingredients. It is very rare to use waste materials for growth media, especially from banana peels.

Banana peel has a very high potential to be used as a growth medium by utilizing the content of banana peel which is still very high in carbohydrate. Utilization of banana peels must be formulated appropriately to determine the exact composition of the growth medium to support fungal growth. The earliest composition that can be used is the composition of the standard gold media, namely potato dextrose agar and Sabouraud dextrose agar. The Fungal chosen in this study was a group of fungi which found as pathogen in human, which are *Candida albicans*<sup>9</sup>, *Aspergillus fumigatus*<sup>10</sup>, and *Aspergillus flavus*.<sup>11</sup>

The purpose of this study was to determine the potential of banana peel media in supporting the growth of fungi, namely *Candida albicans*, *Aspergillus*

*fumigatus* and *Aspergillus flavus*. To achieve this goal, media testing was carried out with variations in the mass composition of banana peels which were then evaluated with the results of the growth of the test fungi on banana peel media. The results of this study can be used to utilize banana peel media with the right media composition to support the growth of fungi, especially *Candida albicans*, *Aspergillus fumigatus* and *Aspergillus flavus*.

### METHODS

#### Materials

Pure culture of *Candida albicans* ATCC 10231, *Aspergillus fumigatus*, and *Aspergillus flavus* were obtained from Balai Besar Laboratorium Kesehatan (BBLK) Surabaya. Cavendish banana peel flour, bacteriological agar (MERCK), dextrose, Sabouraud Dextrose Agar (MERCK), Potato Dextrose Agar (MERCK), distilled water, NaCl (SAP Chemical). Analytical balance (OHAUS), autoclave (Hirayama HVE-50), incubator (Memmert),

standard loop 1 $\mu$ L (SPL Life science), petri dish (Anumbra), Erlenmeyer (Iwaki), wire loops, measuring pipette (Iwaki), measuring glass (Iwaki), pH meter (walklab HP9000), Bunsen, 100mesh sieved.

#### Data collection procedures

Fungal pure culture preparation: *Candida albicans* was subcultures on Potato Dextrose Agar (PDA) using the streak method, and incubated in an incubator at 37°C for *Candida albicans* for 48 hours. Meanwhile, *Aspergillus flavus* and *Aspergillus fumigatus* were subcultures on Sabouroud Dextrose Agar (SDA) using the streak method incubated at 27-29°C for 72 hours.

Banana Peels flour preparation: Cavendish banana peels were washed under running water, then cut into small pieces. Banana peels were then dried in an oven at 60-65°C for 5 hours. Blend the banana peels to powder form. The results obtained were then sieved using a 100mesh sieve.

Banana Peels media preparation: The media consisted of banana peel flour, dextrose, distilled water and agar. For 100mL of media, composed of banana peel flour (1gr, 2gr, 3gr, 4gr, 8gr), 2gr dextrose, and 100mL distilled water. The media then allowed to boiling for 5 minutes. After media allowed to cool down, the pH of the media was measured and adjusted to 5.5-5.7. The final volume of the media was calculated, if it were less than 100mL then need to add distilled water until it reached total volume of 100mL. Then add 1.5 grams of agar, stir and heat until boiling and homogeneous. The media was then sterilized using an autoclave at 121C 1 atm for 15 minutes. The media is then poured into a sterile petri dish aseptically.

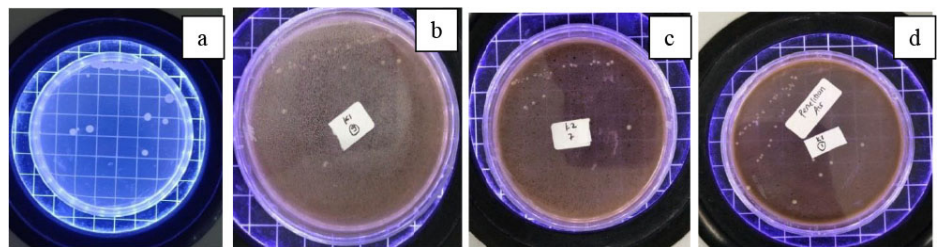
Fungal pure culture inoculation: Fungal cultures used were fresh cultures aged 48 hours for *Candida albicans* and 72 hours for *Aspergillus flavus* and *Aspergillus fumigatus*. The tested fungi were then

suspended in physiological water (0.85% NaCl) until the turbidity reached the McFarland standard of 0.5. *Candida albicans* was then inoculated onto the surface of the test medium using a 1 $\mu$ L standard loop by streaking. *Aspergillus flavus* and *Aspergillus fumigatus* were inoculated onto the surface of the sterile test medium using a standard loop by spotting it in the middle of the medium. Incubation was carried out at 37°C for 48 hours for *Candida albicans*, and 27-29°C for 3, 5, 7 and 10 days.

#### Data analysis

The data obtained in this study includes qualitative and quantitative data. Qualitative data includes the growth characteristics (colony morphology) of the fungi on the test medium and the control/gold standard media. Colony morphology's were quantified according to previous study for *Candida albicans*<sup>6</sup>. Meanwhile colony morphology's of *Aspergillus fumigatus* and *Aspergillus flavus* were quantified according previous study<sup>5,12</sup>.

Quantitative data included the number of *Candida albicans* colonies that grew on test media and control media / gold standard. Quantitative data were also obtained from the development of diameter of *Aspergillus fumigatus* and *Aspergillus flavus* colony on test media and control/gold standard media which observed on days 3, 5, 7 and 10. Quantitative data were statistically analyzed using Mann-Whitney.



**Figure 1.** *Candida albicans* growth in tested media at 48 hours incubation. (a) growth in SDA; (b) growth in 1 gr banana peels flour media; (c) growth in 2 gr banana peels flour media; (d) growth in 3 gr banana peels flour media.

## RESULTS

### Banana Peels Species Analysis

The banana peel specimens used in this study had previously been tested to determine the species of the plant used. Test was carried out at UPT Laboratorium Herbal Materia Medica Batu, City of Batu. The test showed that the species of banana peel tested was *Musa acuminata* Colla cavendish.

### Morphology of Fungal Culture in Banana Peels Media

In general, the tested fungi were divided into two groups, namely the yeast and mold groups. These two types of fungi have differences in terms of growth morphological characteristics and growth rates in the media. This study used two types of gold standard media, namely Potato dextrose agar (PDA) and Sabouraud dextrose agar (SDA). PDA is a common medium used to grow fungi, which in this study was used to grow *Candida albicans*. While SDA is a medium used to grow dermatophytes and other fungi, which in this study was used to grow *Aspergillus fumigatus* and *Aspergillus flavus*.

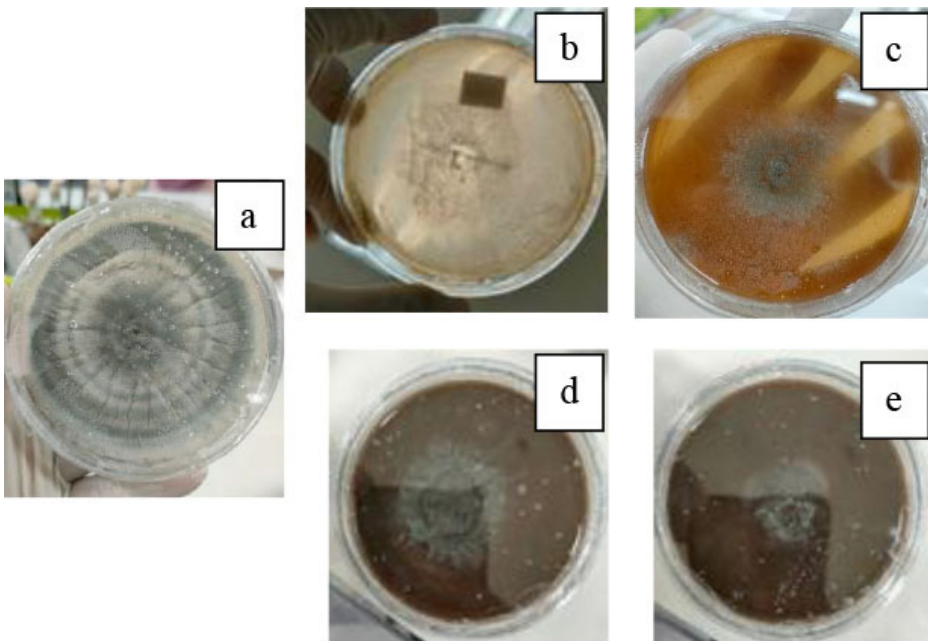
*Candida albicans* was tested on control media and banana peel media with concentration variants of 1%, 2%, and 3%. Tests were carried out to see the morphology and number of colonies obtained in each medium. In terms of colony morphology, the growth of *Candida albicans* on PDA media as a gold standard has the characteristics of a round

**Table 1.** *Candida albicans* colony morphology scoring

Media Tested	Form	Color	Margin	Size	Total Scoring
PDA	1	1	1	4	7
Banana Peels Media 1% (1gr/100mL)	1	1	1	2	5
Banana Peels Media 2% (2gr/100mL)	1	1	1	2	5
Banana Peels Media 3% (3gr/100mL)	1	1	1	3	6

**Table 2.** *Aspergillus fumigatus* colony morphology scoring

Media Tested	Form	Color	Texture	Metabolites drops	Concentric circle	Radial Furrow	Abundance	Total Scoring
SDA	2	2	3	1	1	1	3	12
Banana Peels Media 1% (1gr/100mL)	1	1	2	0	1	0	1	6
Banana Peels Media 2% (2gr/100mL)	2	2	2	0	1	0	2	9
Banana Peels Media 4% (4gr/100mL)	2	2	2	0	1	0	2	9
Banana Peels Media 8% (8gr/100mL)	2	2	2	0	0	0	1	7

**Figure 2.** *Aspergillus fumigatus* growth in tested media at 10 days incubation. (a) growth in SDA; (b) growth in 1 gr banana peels flour media; (c) growth in 2 gr banana peels flour media; (d) growth in 4 gr banana peels flour media; (e) growth in 8 gr banana peels flour media.

shape, white color, flat edges and medium size categories. Growth on banana peel media showed similar result as in PDA but with a smaller size. The largest size of the *Candida albicans* colonies was obtained from banana peel media with a concentration variant of 3%, which is small in size categories. While banana peel media with concentration variants of 1%, 2% showed the growth of *Candida albicans* colonies which had pin point size categories. The colony morphology of *Candida albicans* illustrated in Figure 1.

Comparison of each colony morphology in this study were presented by its total scoring (Table 1). By measuring its total scoring, the colony morphology of *Candida albicans* in PDA were more superior comparing to banana peel media.

The most represent morphology colony of *Candida albicans* from banana peels were 3% variant.

Tests on banana peel media were also carried out for two types of *Aspergillus*, namely *Aspergillus fumigatus* and *Aspergillus flavus*. Tests were carried out on banana peel media with variants of 1%, 2%, 4%, and 8%. Observation of morphological characters on banana peel media included shape, color, metabolite drops, concentric circles, radial furrows, and abundance. *Aspergillus fumigatus* on SDA media has morphological characteristics of a round shape, gray-green color, granular texture, has metabolite drops, has concentric circles and radial furrows with good abundance. While growth on banana peel media had colony characters of irregular

to spherical shape, white to gray-green in color, had no metabolite drops, no radial furrows were seen and a slight to moderate abundance (Table 2).

Based on the growth results at 10 days of incubation (Figure 2) it was found that the growth of *Aspergillus fumigatus* on SDA media was better than on banana peel media. Growth on banana peel media shows better results when adding banana peel mass to the media, up to a maximum of 4%. When added 8% obtained the opposite result. To facilitate comparison, scoring for *Aspergillus fumigatus* colony morphology was performed on each medium. The scoring results showed that the best colony morphology was obtained on SDA media, while the banana peel media which gave good results was shown on the 4% variant.

*Aspergillus flavus* growth at 10 days of incubation in each media can be seen in Figure 3. Colony morphology of *Aspergillus flavus* in SDA media were round, green, velvety, has concentric circle, good growth abundance (Table 3). Meanwhile there were vary in colony morphology when growing in banana peel media. If using small mass of banana peels (1%), colony growth were poor, but when growing in 2% and 4% colony morphology were better. Banana peel media 8% variant showed moderate growth in colony morphology. This result was opposite of colony morphology of *Aspergillus fumigatus*. The *Candida albicans* colony number and the colony diameters of *Aspergillus fumigatus* and *Aspergillus flavus* showed in Table 4-6.

## DISCUSSION

The test showed that the species of banana peel tested was *Musa acuminata* Colla cavendish. The plant has the characteristics

of a tree shape with a height of 2.5-3 m. The stem is the part commonly called the hump, while what is commonly called the stem is the sheath of the leaf. Stems are dark green. Single leaf, dark green. The fruit is in the form of bunches, the length of the bunch is 60-100cm and the weight is 15-30kg, each bunch consists of 8-13 combs and each comb consists of 12-22 fruits, the flesh is yellowish-white, the taste is sweet, slightly sour, the skin is rather thick, the color is yellowish green when young, and becomes a fine light yellow when old.

There are 3 varieties of *Musa acuminata* that have been studied for the moisture and

oil content found in the ripe fruit skin. The 3 variants were *Musa acuminata* balbisina, *Musa acuminata* Cavendish, and *Musa acuminata* Colla.<sup>13</sup> The Cavendish variant exhibits a high moisture and oil content.

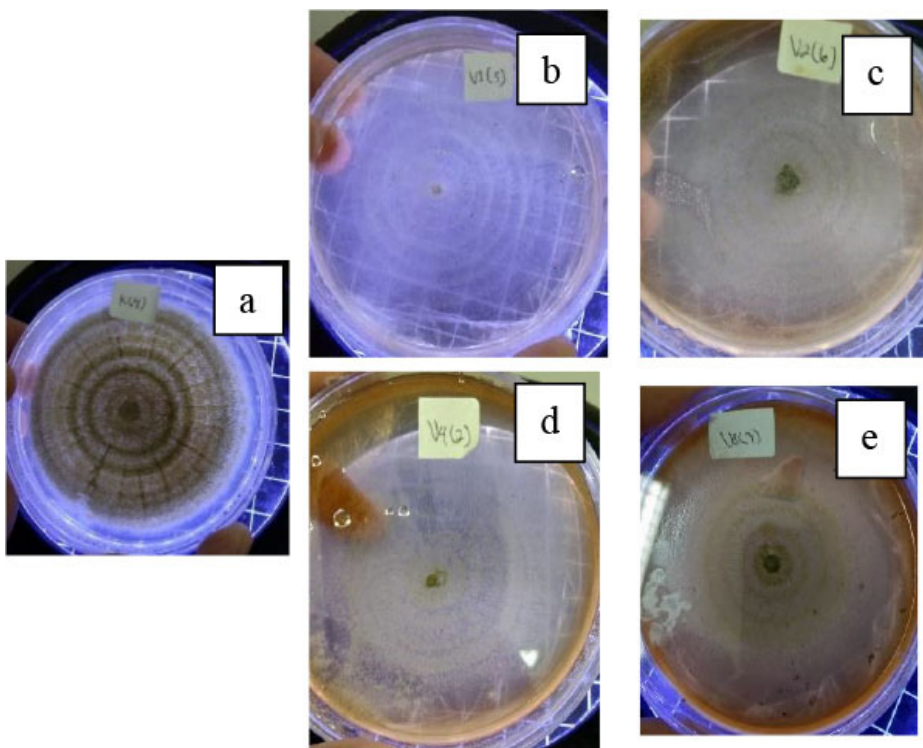
Evaluation of fungal growth in banana peels media not only in colony morphological characteristic, but also number of colony and diameters of colony. As growth media, banana peel media can support fungi growth in number even though its colony morphologies were inferior than the gold standard media. *Candida albicans* showed increasing number when growing in the banana

peels media using 3% variant. Statistical analysis showed that there were significant differences in the control and treatment groups ( $p < 0.00$ ). The results shown by banana peel media are quite good, this is because previous studies used several sources of non-waste carbohydrates to be used as alternative media for the growth of *Candida albicans*.<sup>14</sup>

*Aspergillus fumigatus* has a unique development in growth of colony diameters. Banana peel media 1% and 2% had slow growth. However, for banana peel media with 4% had growth inhibition in the first 3 days, but then continue to growth. In the 8% variant of banana peel media, growth was inhibited on days 3 and 5. New growth was seen on day 7, but the diameter shown was quite different from the colonies that grew on 4% banana peel media. The results shown are different from previous studies that grow clinically important fungi on banana peels. This could be due to differences in the type of sugar added.<sup>15</sup>

*Aspergillus flavus* has a vary development in growth of colony diameters. When using banana peels media 1% and 2% variant, the growth has a rapid pace, but colony morphology only in the form bundle of fiber. When using banana peels media 2% and 4%, there's slower growth in colony diameters, but the colony morphology much better than in banana peels media 1% and 2% variant. Statistical analysis showed that there were significant differences in the control and 8% treatment groups ( $p < 0.00$ ).

Banana peel has been widely studied for its proximate content. In addition to the carbohydrate, fat and moisture content, banana peels contain several minerals in them. Some of the minerals



**Figure 3.** *Aspergillus flavus* growth in tested media at 10 days incubation. (a) growth in SDA; (b) growth in 1 gr banana peels flour media; (c) growth in 2 gr banana peels flour media; (d) growth in 4 gr banana peels flour media; (e) growth in 8 gr banana peels flour media.

**Table 3.** *Aspergillus flavus* colony morphology scoring

Media Tested	Form	Color	Texture	Metabolites drops	Concentric circle	Radial Furrow	Abundance	Total Scoring
SDA	2	3	3	0	1	0	3	12
Banana Peels Media 1% (1gr/100mL)	2	1	1	0	1	0	1	6
Banana Peels Media 2% (2gr/100mL)	2	2	2	0	1	0	2	9
Banana Peels Media 4% (4gr/100mL)	2	2	2	0	1	0	2	9
Banana Peels Media 8% (8gr/100mL)	2	3	2	0	1	0	2	10

### Fungal growth of Fungal Culture in Banana Peels Media

**Table 4.** *Candida albicans* colony number in tested media

	Groups Tested Media			
	PDA as gold standard media	Banana Peels Media 1% (1gr/100mL)*	Banana Peels Media 2% (2gr/100mL)**	Banana Peels Media 3% (3gr/100mL) ***
Average of Colony Numbers (CFU/ $\mu$ L)	14.83 $\pm$ 2.71	12.33 $\pm$ 1.75	20.33 $\pm$ 1.97	27.00 $\pm$ 7.04

\*1 gr banana peels flour per 100mL distilled water; \*\*2 gr banana peels per 100mL distilled water; \*\*\*3 gr banana peels per 100mL distilled water.

**Table 5.** *Aspergillus fumigatus* colony diameters in tested media

Groups Tested Media	Colony diameter of <i>Aspergillus fumigatus</i> (cm)			
	Day 3	Day 5	Day 7	Day 10
SDA	2.38 $\pm$ 0.57	4.62 $\pm$ 0.54	6.27 $\pm$ 0.44	8.00 $\pm$ 0.00
Banana Peels Media 1% (1gr/100mL)*	0.62 $\pm$ 0.23	2.98 $\pm$ 0.42	4.02 $\pm$ 0.44	4.90 $\pm$ 0.50
Banana Peels Media 2% (2gr/100mL)**	0.91 $\pm$ 0.40	1.97 $\pm$ 0.46	2.57 $\pm$ 0.32	3.35 $\pm$ 0.53
Banana Peels Media 4% (4gr/100mL)***	0.0 $\pm$ 0.0	2.16 $\pm$ 0.58	2.91 $\pm$ 0.47	3.41 $\pm$ 0.55
Banana Peels Media 8% (8gr/100mL)****	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	1.27 $\pm$ 0.21	1.90 $\pm$ 0.45

\*1 gr banana peels flour per 100mL distilled water; \*\*2 gr banana peels per 100mL distilled water; \*\*\*4 gr banana peels per 100mL distilled water; \*\*\*\*8 gr banana peels per 100mL distilled water.

**Table 6.** *Aspergillus flavus* colony diameters in tested media

Groups Tested Media	Colony diameter of <i>Aspergillus flavus</i> (cm)			
	Day 3	Day 5	Day 7	Day 10
SDA	3.29 $\pm$ 0.27	4.44 $\pm$ 0.46	6.69 $\pm$ 0.50	7.51 $\pm$ 0.27
Banana Peels Media 1% (1gr/100mL)*	2.53 $\pm$ 0.15	5.15 $\pm$ 0.21	6.11 $\pm$ 0.54	7.24 $\pm$ 0.09
Banana Peels Media 2% (2gr/100mL)**	2.78 $\pm$ 0.46	4.49 $\pm$ 0.47	5.68 $\pm$ 0.62	7.20 $\pm$ 0.33
Banana Peels Media 4% (4gr/100mL)***	2.28 $\pm$ 0.10	3.66 $\pm$ 0.16	3.66 $\pm$ 0.16	6.61 $\pm$ 0.10
Banana Peels Media 8% (8gr/100mL)****	2.15 $\pm$ 0.19	3.31 $\pm$ 0.24	5.86 $\pm$ 0.21	6.98 $\pm$ 0.23

\*1 gr banana peels flour per 100mL distilled water; \*\*2 gr banana peels per 100mL distilled water; \*\*\*4 gr banana peels per 100mL distilled water; \*\*\*\*8 gr banana peels per 100mL distilled water.

found include Na, K, Mn, P, Ca, Zn, and Fe. The content of banana peels will vary when compared between ripe and unripe fruit. Ripe cavendish banana skin contains 15.5% moisture, 2.41% protein, 3.25% fat, 14.7% ash, 15.2% mixed fiber, 51.3% carbohydrates and 2.35% fatty acids.<sup>16</sup> The presence of nutrients and minerals in the banana peel support the growth of the test fungi. The best carrying capacity for the growth of *Candida albicans* is 3%. Meanwhile, the carrying capacity for the growth of *Aspergillus fumigatus* was better in the 2% variant of banana peel media. *Aspergillus flavus* shows optimal growth at 8%.

*Aspergillus fumigatus* has slower development during 3 days to 5 days incubation when grew in 4% and 8% banana peel media. One of the cause for delayed growth was others compound of banana peel. In a ripe cavendish banana peel

there are 14.8% phenolics, and has 3.75% antioxidant capacity.<sup>16</sup> Phytochemical analysis and antimicrobial activity of banana peels showed the presence of tannins, flavonoids, glycosides, phenols and steroids. Antibacterial activity testing showed inhibition of the tested bacteria.<sup>17</sup> Some of the benefits of banana peels are that they can be used for antifungal and anti-bacterial properties.<sup>18-22</sup> However, it takes a high concentration to show inhibition on the tested fungus. Therefore, the recommended concentration for use as a growth medium for the test fungus is 2%.

### CONCLUSION

Banana peels media can be used for the growth media of the tested fungi, and it is recommended to use the 2% (w/v) variant so that it can be used to grow all the tested fungi in this research. For future research,

it is necessary to find the right method to completely dissolve flour in the media.

### ACKNOWLEDGMENT

Gratitude is given to Universitas Nahdlatul Ulama for the facilities used in this research. Gratitude is also given to the staff of the microbiology laboratory at the Universitas Nahdlatul Ulama Surabaya, who have helped during the research. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### AUTHOR CONTRIBUTION

EP carried out research concept, supervising research, evaluating data research, and drafted the manuscript. HD, NA, and KN carried out research preparation material, data collecting and statistical data analysis in each fungal used

in this research. HD handling *Aspergillus fumigatus*, NA handling *Candida albicans* and KN handling *Aspergillus flavus*.

## CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## ETHICAL CLEARANCE

This research was an in-vitro study using pure cultures of the fungus obtained from the Balai Laboratorium Kesehatan Surabaya. Pure fungal cultures were obtained with permit No. 302/UNUSA-FKES/Akd.1.2.2.4/V/2022, and signing of a statement of ability to handle specimens of fungi according to the protocol.

## FUNDINGS

This research used independent funds.

## REFERENCES

- Aboul-Enein AM, Salama ZA, Gaafar AA, Aly HF, Bou-Elella FA, Ahmed HA. Identification of phenolic compounds from banana peel (*Musa paradisiaca* L.) as antioxidant and antimicrobial agents. *J Chem Pharm Res*. 2016;8(4):46–55.
- Aini N, Rahayu T. Alternatif Media for Fungal Growth Using a Different Source of Carbohidrats. *Semin Nas XII Pendidik Biol FKIO*. 2015;861–6.
- Naim HJN. Pemanfaatan Bekatul sebagai Media Alternatif untuk Pertumbuhan *Aspergillus* sp. *Media Anal Kesehat*. 2016;7(2):1–6.
- Nuryati A, Sujono. Media Agar Tepung Kacang Hijau, Kacang Merah, Kacang Tunggak, Kacang Kedelai sebagai Media Kultur Jamur *Aspergillus flavus*. *J Teknol Kesehat*. 2017;13(1):23–32.
- Prayekti E, Fahira NN. Media Pertumbuhan Alternatif Dari Tepung Ampas Tahu Untuk Pertumbuhan *Penicillium* sp. *J Celeb Biodiversitas*. 2022;5(1):42–7.
- Prayekti E, Lukiono YT. Penggunaan Tepung Ampas Tahu untuk Media Pertumbuhan *Candida albicans* dan *Candida* sp. *J Indones Med Lab Sci*. 2022;3(2):170–83.
- Berde C V, Berde VB. Vegetable Waste as Alternative Microbiological Media for Laboratory and Industry. *World J Pharm Pharmaceut Sci*. 2015;4(05):1488–94.
- Anbu S, Saranraj P, Padma J, Punithavalli K. Fruits peel waste as a novel media for the growth of economically important Fungi. ~ 426 ~ *J Pharmacogn Phytochem*. 2017;6(6):426–8.
- Mayer FL, Wilson D, Hube B. *Candida albicans* pathogenicity mechanisms. *Virulence*. 2013;4(2):119–28.
- Arastehfar A, Carvalho A, Houbraken J, Lombardi L, Garcia-Rubio R, Jenks JD, et al. *Aspergillus fumigatus* and aspergillosis: From basics to clinics. *Stud Mycol*. 2021;100(2021).
- Rayungsista A, Suhendro G, Fauziah D, Notobroto HB, Zuhria I. Expression of Matrix Metalloproteinase-8 (MMP-8) and Tissue Inhibitors of Metalloproteinase-1 (TIMP-1) after cryotherapy in *Aspergillus flavus* keratitis at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. *Bali Med J*. 2022;11(2):747–51.
- Prayekti E, Sumarsono T. Analisis Jumlah Dan Morfologi *Penicillium* spp Pada Media Ampas Tahu. *J SainHealth*. 2019;3(2):1–8.
- Hamid HA, Abdollah MFB, Masripan NAB, Hasan R. Characterization of Raw and Ripen of Banana Peel wastes and It's Oils extraction using Soxhlet Method. *Int J Appl Chem*. 2016;12(1):1–5.
- Nurdin E, Nurdin GM. Perbandingan Variasi Media Alternatif dengan Berbagai Sumber Karbohidrat Terhadap Pertumbuhan *Candida albicans*. *Bionature*. 2020;21(1):1–5.
- Ekwe DC, Ekwebelem OC, Eze EA. Studies on the Proximate Contents and Potentials of *Musa sapientum* and *Persea americana* Fruits Peel as Media for the Growth of Medically Important Fungi. *J Adv Microbiol*. 2020;(July):30–6.
- Ibiyinka O, Akinwumi Oluwafemi A, Adebayo O O, Olugbenga Kayode P. Comparative study of chemical composition and evaluation of the In-Vitro antioxidant capacity of unripe and ripe banana species (*Musa Sapientum*) biowastes. *Int J Agric Sci Food Technol*. 2021;7:061–6.
- Bashir F, Hassan A, Mushtaq A, Rizwan S, Jabeen U, Raza A, et al. Phytochemistry and antimicrobial activities of different varieties of banana (*Musa acuminata*) peels available in Quetta city. *Polish J Environ Stud*. 2021;30(2):1531–8.
- Suwanto, Zahroh R, Fatmawati L. Review : Efikasi pisang (*Musa paradisiaca* L) Sebagai Tanaman Obat. In: Abdurahman F, Aini N, Triliana R, editors. MALANG: Fakultas Kedokteran Universitas Islam Malang; 2017. p. 77–85.
- Maulana R, Zulfa F, Setyaningsih Y. Uji Efektivitas Ekstrak Kulit Pisang Ambon (*Musa paradisiaca* var. *Sapientum* L.) Terhadap Pertumbuhan *Trichophyton Rubrum* Secara In Vitro. *Semin Nas Ris Kedokt*. 2020;1(1):1–7.
- Rohmansyah R, Dowes M, Kristiyanto A, Imam K. The different effects of banana juice and sport drink on lactic acid among volleyball students in Surakarta. *Bali Med J*. [Internet]. 2019 Aug. 1 [cited 2023 Apr. 30];8(2):513-7. Available from: <https://balimedicaljournal.org/index.php/bmj/article/view/1455>.
- Purnawati S, Wrasiasi LP, Jaya Lesmana CB, Sandra Megantara, Lesmana R. A study of molecular docking of l-tryptophan ligand as a compound in pineapples and bananas binding with the human serotonin transporter (SERT). *Bali Med J*. [Internet]. 2022 Sep. 23 [cited 2023 Apr. 30];11(3):1243-9. Available from: <https://balimedicaljournal.org/index.php/bmj/article/view/3526>.
- Indriawati R, Rahmawati MD, Hidayati T. The use of Kepok Banana Stem (*Musa paradisiaca*) in diabetes rats does not reduce Malondialdehyde (MDA) levels. *Bali Med J*. [Internet]. 2022 Nov. 15 [cited 2023 Apr. 30];11(3):1636-9. Available from: <https://balimedicaljournal.org/index.php/bmj/article/view/3690>.



This work is licensed under a Creative Commons Attribution