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Identification of *Aspergillus sp* Fungus in Corn Rice *(Zea mays L)* Based on Storage Duration in the Sumberkolak Situbondo Region

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ABSTRACT

Corn rice is one of the staple foods that can be used as a substitute for regular rice and is susceptible to contamination by microorganisms such as fungi. Based on observations, the community in Situbondo, particularly in the Sumberkolak region, still consumes corn rice as a primary food source alongside regular rice. The local community stores a large quantity of corn rice for an extended period. The corn rice is obtained from sellers in the Sumberkolak area of Situbondo Regency. This research aimed to identify Aspergillus sp fungi in corn rice based on storage duration ranging from 1 week to 4 weeks. This research was conducted at the Parasitology Laboratory, Department of Medical Laboratory Technology, Poltekkes Kemenkes Surabaya, from November 2022 to June 2023. The experimental method used in this study was the pour plate method. Four treatments were applied to each sample of corn rice, with a total of 4 samples obtained using the Slovin formula. The results of this research indicated that the optimal growth of *Aspergillus sp* fungi occurs during the 2-week to 4-week storage period. Three species were found: *Aspergillus flavus*, *Aspergillus fumigatus*, and *Aspergillus niger* identified through macroscopic and microscopic characteristics that correspond to the aforementioned three fungal species.

Keywords: corn rice; storage duration; *Aspergillus sp.*

INTRODUCTION

Corn is a potential commodity to be developed into an alternative staple food due to its significant production volume and nutritional content, particularly in terms of protein and carbohydrates, which are comparable to rice. Additionally, the process of converting corn into ready-to-consume food is relatively easy, and people are accustomed to consuming it. One of the products that can be developed as part of food diversification from corn is corn rice. Considering its nutritional content, corn rice can be used as a staple food alongside rice.(1-4)

One well-known corn product in the community is corn rice. Corn rice is not a new food item for some rural communities in Indonesia. During times of food scarcity and famine, they choose alternative food sources, one of which is consuming corn rice as a substitute for regular rice.(5-7)

Aspergillus is a fungus that forms long branching filaments and develops mycelium and conidiospores in culture media. *Aspergillus* reproduces by forming hyphae or buds and produces conidiophores that generate spores. Its spores are freely distributed in the open air, making inhalation unavoidable, and they can enter the respiratory tract and lungs. As a tropical country, Indonesia provides a fertile environment for the growth of fungi. Consequently, fungal diseases often afflict the population.(8)

Species that often cause diseases are *Aspergillus fumigatus*, *Aspergillus flavus*, *Aspergillus niger*, and *Aspergillus terreus.* Among them, *Aspergillus fumigatus* is the most pathogenic species, capable of growing at temperatures as high as 37°C and even up to 50°C. Other species such as *Aspergillus nidulans*, *Aspergillus oryzae*, and others, although rarely reported, can also cause diseases.(9-11)

The storage of corn in open storage areas and humid tropical regions like Indonesia can lead to corn spoilage. Dried corn stored in humid environments can absorb moisture from the surroundings, creating favorable conditions for the growth of *Aspergillus flavus*. Corn contaminated with *Aspergillus flavus* generally contains aflatoxins formed during the growth of the fungus.(12)

Aflatoxin is a highly toxic secondary metabolite produced by *Aspergillus flavus* and *Aspergillus parasiticus*. These fungi commonly contaminate agricultural-based food and feed materials, such as corn and

peanuts. The suitable environmental conditions in Indonesia, such as humidity, moisture content, and temperature, support their growth. Research on aflatoxin contamination requires aflatoxin standards.[13]

Considering the ease with which this mold proliferates and produces toxins in the form of aflatoxins, the handling of corn and its processed products should be given special attention. Starting from the harvesting process, storage, and distribution, which ultimately leads to the production of various products. For example, in the storage process, temperature, humidity, and moisture content should be carefully monitored and adjusted according to established standards.[14]

Based on observations, the community in Situbondo, especially in the Sumberkolak region, still consumes corn rice as a staple food alongside regular rice. Additionally, it is a fact that the local community stores a large quantity of corn rice for an extended period. To prevent contamination by Aspergillus sp, it is necessary to research to determine the presence of Aspergillus sp fungi in corn rice based on storage duration.

As problem statement: "Is there any *Aspergillus sp fungus* in corn rice based on storage duration in the Sumberkolak area of Situbondo?" The general objective of this research is to analyze the presence of *Aspergillus sp fungus* in stored corn rice based on storage duration.

The benefit for the community is to enhance knowledge and awareness among the public regarding the characteristics of food products that have been affected by fungal microorganisms in corn rice based on storage duration. The benefit for the health department is that this research is expected to provide information and insights for the health department in conducting supervision, examination, and guidance on corn rice food products consumed by the community. The benefit for medical laboratory technologists is that this research is expected to make them more competent and skilled in the field of mycology, particularly in the growth of Aspergillus sp fungi in corn rice. It will provide them with new references that can be used for further research purposes.

METHODS

The specific objectives of this research were as follows: 1) to analyze the presence of *Aspergillus sp fungus* in corn rice based on a 1-week storage duration; 2) to analyze the presence of *Aspergillus sp fungus* in corn rice based on a 2-week storage duration; 3) to analyze the presence of *Aspergillus sp fungus* in corn rice based on a 3-week storage duration; 4) To analyze the presence of *Aspergillus sp fungus* in corn rice based on a 4-week storage duration; 5) to analyze the presence or absence of *Aspergillus sp fungus* in corn rice based on a storage duration ranging from 1 week to 4 weeks.

This research was a quantitative study conducted through laboratory experiments. The experiment was carried out using SDA (Saboraud Dextrose Agar) as the growth medium, using the Pour Plate method.

RESULTS

The results obtained from the conducted research were used to determine the differences in the growth of *Aspergillus sp* fungi based on storage duration ranging from 1 week to 4 weeks. This experiment was conducted using SDA (Saboraud Dextrose Agar) medium and the Pour Plate method (Agar Pouring).

Table 1. Data from sample 1: number of *Aspergillus sp* fungal colonies based on storage duration

Storage duration	Number of *Aspergillus sp* colonies					Number of colonies	Mean
	Replication						
	1	2	3	4	5		
1 week	-	-	-	-	-	0	0
2 week	5	7	5	6	5	28	5.6
3 week	51	57	50	54	50	262	52.4
4 week	∞	∞	∞	∞	∞	∞	infinity

Table 2. Data from sample 2: number of *Aspergillus sp* fungal colonies based on storage duration

Storage duration	Number of *Aspergillus* sp colonies					Number of colonies	Mean
	Replication						
	1	2	3	4	5		
1 week	-	-	-	-	-	0	0
2 week	8	10	7	6	13	44	8.8
3 week	53	59	60	57	55	284	56.8
4 week	∞	∞	∞	∞	∞	∞	infinity

Based on Table 1 in sample 1, in the first week, there was no growth of *Aspergillus sp* fungi. In the second week, there were 11 colonies of *Aspergillus niger*, 15 colonies of *Aspergillus flavus*, and 2 colonies of *Aspergillus fumigatus*. In the third week, there were 184 colonies of *Aspergillus niger* and 76 colonies of *Aspergillus flavus*. In the fourth week, there were an infinite number of colonies of *Aspergillus niger* and *Aspergillus flavus*.

Based on Table 2 in sample 2, in the first week, there was no growth of *Aspergillus sp* fungi. In the second week, there were 21 colonies of *Aspergillus niger* and 23 colonies of *Aspergillus flavus.* In the third week, there were 283 colonies of *Aspergillus niger* and 1 colony of *Aspergillus flavus*. In the fourth week, there were an infinite number of colonies of *Aspergillus niger* and *Aspergillus flavus*.

Table 3: Data from sample 3: number of *Aspergillus sp* fungal colonies based on storage duration

Storage duration	Number of *Aspergillus sp* colonies					Number of colonies	Mean
	Replication						
	1	2	3	4	5		
1 week	-	-	-	-	-	0	0
2 week	8	5	8	6	9	36	7,2
3 week	61	57	63	55	58	294	58,8
4 week	∞	∞	∞	∞	∞	∞	infinity

Table 4: Data from sample 4: number of *Aspergillus sp* fungal colonies based on storage duration

Storage duration	Number of *Aspergillus sp* colonies					Number of colonies	Mean
	Replication						
	1	2	3	4	5		
1 week	-	1	-	-	-	1	0,2
2 week	4	7	6	10	5	32	6,4
3 week	55	53	57	60	52	277	55,4
4 week	∞	∞	∞	∞	∞	∞	infinity

Based on Table 3 in sample 3, in the first week, there was no growth of *Aspergillus sp* fungi. In the second week, there were 22 colonies of *Aspergillus niger,* 13 colonies of *Aspergillus flavus,* and 1 colony of *Aspergillus fumigatus.* In the third week, there were 196 colonies of *Aspergillus niger* and 98 colonies of *Aspergillus flavus.* In the fourth week, there were an infinite number of colonies of *Aspergillus niger* and *Aspergillus flavus*.

Based on table 4 in sample 4, in the first week, there was 1 colony of *Aspergillus niger.* In the second week, there were 8 colonies of *Aspergillus niger* and 24 colonies of *Aspergillus flavus*. In the third week, there were 79 colonies of *Aspergillus niger* and 198 colonies of *Aspergillus flavus*. In the fourth week, there were an infinite number of colonies of *Aspergillus niger* and *Aspergillus flavus*.

DISCUSSION

Based on the research results from 4 samples of corn rice, it is indicated that the corn rice sold in the Sumberkolak Situbondo region is positively contaminated by *Aspergillus sp* fungi. This can be observed through macroscopic and microscopic examinations, which show the presence of the fungi. The identified types of *Aspergillus sp* fungi include *Aspergillus niger*, *Aspergillus flavus*, and *Aspergillus fumigatus*. This identification is based on macroscopic and microscopic features that are consistent with the characteristics of the three fungal species mentioned above. *Aspergillus niger* is identified by its macroscopic characteristics of being black in color and having a round shape resembling sand grains or coffee powder. Its microscopic features include non-septate hyphae, the presence of conidia, and round-shaped conidiophores containing spores. *Aspergillus flavus* is identified by its macroscopic characteristics of dark green to brownish color and a cotton-like appearance on the surface. Microscopically, it is characterized by septate hyphae and round-shaped conidia and conidiophores. *Aspergillus fumigatus* is identified by its macroscopic characteristics of light green to dark green color and a clustered, sand-like appearance. Under the microscope, it has long, slender, and branched hyphae. It also possesses conidiophores that contain spores.[15-17]

Some species of *Aspergillus sp* have the potential to produce toxic compounds known as mycotoxins. These mycotoxins can have negative effects on humans and animals if exposed to a significant amount. Mycotoxin contamination is influenced by both the storage and processing processes of corn. During harvest, corn contains high moisture content (25-30%), making it susceptible to contamination by *Aspergillus flavus*, the main producer of a mycotoxin called aflatoxin.[18] Aflatoxin can be lethal when consumed in high concentrations, and long-term exposure to low levels of aflatoxin can lead to liver or kidney cancer.[19] *Aspergillus niger* is capable of producing a toxin called ochratoxin. While *Aspergillus flavus* and *Aspergillus fumigatus* produce aflatoxins.[20] Among them, *Aspergillus flavus* is the primary producer of cyclopiazonic acid.[21]

From the above explanation, it can be understood that every process from harvesting, storage, and production, to the distribution of corn rice, has a significant impact on the spread of *Aspergillus sp* fungi. The cleanliness of the environment and storage facilities, starting from the raw corn collectors to the producers and even at the retail level, plays a crucial role in ensuring the quality of the food product. Education and awareness campaigns should be conducted for corn farmers and producers to reduce the spread of contamination from

harmful mycotoxin-producing fungi. Conducting feasibility tests on production materials before distribution is also necessary as an early precaution against mycotoxin contamination.

CONCLUSION

The conclusion is that the optimal growth of *Aspergillus sp* fungi in corn rice occurs during the storage period ranging from 2 weeks to 4 weeks. This suggests that the risk of fungal contamination, particularly Aspergillus species, increases with longer storage durations. Therefore, it is recommended to ensure proper storage conditions and minimize the storage duration of corn rice to maintain its quality and reduce the potential health risks associated with fungal contamination.

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