

# Xerophilic Moulds Isolated from Salted and Unsalted Dried Fish from Traditional Markets in Jakarta

I. Santoso, I. Gandjar, R.D. Sari, and N.D. Sembiring

Faculty of Mathematics and Natural Sciences, University of Indonesia

## ABSTRACT

A study was carried out on the mycoflora of unsalted (30 samples) and salted (30 samples) dried fish sold at traditional markets in Jakarta and vicinity. Only the moulds growing directly on the surface on the fish were isolated. The isolates were identified until the species level using the common suitable recommended media. For examination of their xerophilic features DG18% Agar was used. The species isolated from both kind of samples belong to the genera *Absidia*, *Aspergillus*, *Chaetomium*, *Cladosporium*, *Doratomyces*, *Fusarium*, *Moniliella*, *Mucor*, *Neurospora/Chrysonilia*, *Nigrospora*, *Rhizopus*, *Sordaria*, and *Syncephalastrum*. The strong xerophilic isolates belong to the species *Aspergillus awamori*, *Asp. carbonarius*, *Asp. glaucus*, *Asp. tamaritii*, and *Eurotium glaucus*.

## INTRODUCTION

The availability of basic foodstuffs, its safety and nutritional value, and health condition of the people are a serious concern of the government. To overcome the potential shortages of food, especially plant and animal protein, and to minimize the risk of malnutrition of the young generation, all efforts has been carried out.

Fish is an important protein source in Indonesia. The left-over raw fish with low economic value are usually dried as a preservation method, because in the tropics fish spoils very Rapidly due to the humid and warm climate which is a favorable condition for microbial growth. In Indonesia, this kind of spoilage is commonly prevented by drying the salted and unsalted fish under the sun, because this method is cheap and simple (Moeljanto 1982). The traditional method of fish processing by many cottage makers or home industry manufacturers or by housewives in the villages does not take in consideration the hygienic conditions of the

environment. Before modernization and mechanization of fish processing became really established people will continue to preserve fish in traditional way.

At present, Jakarta has a population of more than 12 million and fish is very popular commodity as a protein source. A survey carried out in a number of traditional markets in Jakarta and surroundings revealed that a number of dried fish showed white spots of mycelia growth on their surface, and usually red spots (Poernomo, *et al.* 1988) are visible due to halophilic bacteria. Poernomo *et al.* (1988) also reported that the deterioration of dried salted fish in Indonesia is often caused by *Polipaecilum pisce*, *Wallemia sebi*, and species belonging to the genus *Aspergillus*. He did not specify the species of the *Aspergillus*. Hocking (1991) frequently found two halophilic moulds, respectively *Polipaecilum pisce* and *Basipetospora halophila* on tropical salted dried fish.

The purpose of this study was to isolate and identify the mould species from salted and unsalted dried fish sold at traditional markets in Jakarta, and to examine which isolates are xerophilic.

## MATERIALS AND METHODS

Thirty samples of salted dried fish and thirty samples of unsalted dried fish were randomly collected from various traditional markets in Jakarta and its vicinity (see Table 1 and Table 2). For isolation of the common moulds present on the samples, 5-6 small pieces of the fish, the size of 1x2 cm were directly plated (Seifert 1990) onto the surface of Dichloran Agar plus Chloramphenicol and incubated at 30°C for 2-5 days. Only the moulds growing directly on the samples were transferred for purity examination and later for identification using the recommended media. For examination of their xerophilic properties the pure cultures were grown on Dichloran 18% Glycerol Agar (Hocking 1991; Samsom *et al.*, 1995). Identification was carried out using the identifi-

cation keys and monographs of Raper and Fennel (1965), Ellis (1971), Pitt (1979), Domsch *et al.* (1993), and Samson *et al.* (1995).

Table 1. The moulds isolated from dried unsalted fish.

Name of the fish	Sampling Location	Species Isolated
Alu-Alu ( <i>Sphyræna forsteri</i> )	Jatinegara	<i>Aspergillus sydowii</i> , <i>Asp. tamarii</i> *, <i>Syncephalastrum racemosum</i>
Baronang ( <i>Siganus javus</i> )	Kramat Jati	<i>Asp. carbonarius</i> , <i>Asp. fumigatus</i> , <i>Asp. glaucus</i> , <i>Eurotium repens</i> , <i>Nigrospora sphaerica</i>
Belut ( <i>Fluta alba</i> )	Jatinegara	<i>Asp. carbonarius</i> , <i>Asp. glaucus</i> *, <i>Asp. tamarii</i> , <i>Neurospora</i> sp., <i>Nigrospora sphaerica</i> , <i>Rhizopus stolonifer</i>
Bilis majang ( <i>Coilia</i> spp.)	Pasar Minggu	<i>Neurospora</i> sp.
Bilis tamban ( <i>Coilia</i> spp.)	Jatinegara	<i>Asp. Awamori</i> , <i>Penicillium italicum</i>
Gabus ( <i>Channa striata</i> )	Tanah Abang	<i>Asp. carbonarius</i> , <i>Asp. tamarii</i> *, <i>Penicillium</i> sp. (2)
Jambrong ( <i>Therapon theraps</i> )	Pasar Minggu	<i>Asp. carbonarius</i> , <i>Asp. glaucus</i> *, <i>Asp. tamarii</i> *, <i>Rh. stolonifer</i>
Jengki 1 ( <i>Stolephorus</i> spp.)	Pasar Minggu	<i>Neurospora</i> sp.
Jengki 2 ( <i>Stolephorus</i> spp.)	Pasar Minggu	<i>Cladosporium sphaerospermum</i> , <i>Fusarium oxysporum</i> , <i>Moniliella</i> , sp., <i>Penicillium</i> sp. (3)
Kapie-Kapie ( <i>Puntius belinka</i> )	Tanah Abang	<i>Asp. tamarii</i> , <i>Eurotium amselodami</i>
Kelapan ( <i>Thryssa mystax</i> )	Pasar Minggu	<i>Asp. carbonarius</i> , <i>Asp. glaucus</i> *, <i>Chaetomium</i> sp., <i>Sordaria fimicola</i> , <i>Syncephalastrum racemosum</i>
Kembung ( <i>Rastrelliger kanagurta</i> )	Jatinegara	<i>Absidia corymbifera</i> , <i>Asp. carbonarius</i> , <i>Neurospora</i> sp.
Lais ( <i>Hemilurus scleronema</i> )	Jatinegara	<i>Asp. carbonarius</i> , <i>Asp. glaucus</i> , <i>Neurospora</i> sp.
Layur ( <i>Trichiurus haumela</i> )	Kramat Jati	<i>Neurospora</i> sp.
Lemuru ( <i>Sardinella longiceps</i> )	Kramat Jati	<i>Nigrospora sphaerica</i>

Name of the fish	Sampling Location	Species Isolated
Market ( <i>Thryssa hamiltonii</i> )	Kramat Jati	<i>Asp. awamori</i> *, <i>Asp. nidulans</i> , <i>Asp. oryzae</i> , <i>Asp. tamarii</i> *, <i>Chaetomium</i> sp., <i>Trichoderma</i> sp.
Mujair ( <i>Tilapia mossambica</i> )	Kramat Jati	<i>Asp. carbonarius</i> , <i>Asp. glaucus</i> *, <i>Neurospora</i> sp., <i>Sordaria fimicola</i>
Petek ( <i>Leiognathus ruconius</i> )	Jatinegara	<i>Asp. carbonarius</i> , <i>Asp. glaucus</i> *
Pisang-pisang ( <i>Caesio caeruleus</i> )	Jatinegara	<i>Asp. carbonarius</i> , <i>Asp. glaucus</i> , <i>Asp. sydowii</i> , <i>Asp. wentii</i> *, <i>Mucor circinelloides</i> , <i>Penicillium</i> sp. (1), <i>Scopulariopsis fusca</i>
Samgeh ( <i>Pseudosciaena sina</i> )	Pasar Minggu	<i>Asp. glaucus</i> , <i>Asp. tamarii</i>
Selar Kuning ( <i>Caranx leptolepis</i> )	Kramat Jati	<i>Asp. tamarii</i> *, <i>Sordaria fimicola</i>
Sepat Siam ( <i>Trichogaster pectoralis</i> )	Jatinegara	<i>Asp. carbonarius</i> , <i>Asp. tamarii</i> , <i>Chaetomium</i> sp., <i>Sordaria fimicola</i>
Talang-talang ( <i>Chorinemus lysan</i> )	Kramat Jati	<i>Asp. tamarii</i> *, <i>Cladosporium sphaerospermum</i> , <i>Neurospora</i> sp.
Tembang ( <i>Sardinella fimbriata</i> )	Jatinegara	<i>Asp. carbonarius</i> , <i>Moniliella</i> sp., <i>Rh. stolonifer</i>
Tengkek ( <i>Megalopsis cordula</i> )	Kramat Jati	<i>Asp. fumigatus</i> , <i>Asp. tamarii</i> , <i>Rh. Stolonifer</i>
Teri Belang ( <i>Stolephorus</i> spp.)	Pasar Minggu	<i>Asp. awamori</i> , <i>Mucor circinelloides</i>
Teri Kata ( <i>Setipinna melanochir</i> )	Pasar Minggu	<i>Asp. awamori</i> *, <i>Asp. tamarii</i> *, <i>Penicillium chrysogenum</i>
Teri Nasi/Medan ( <i>Stolephorus</i> spp.)	Pasar Minggu	<i>Asp. flavus</i> *, <i>Penicillium citrinum</i> , <i>Neurospora</i> sp.
Tetet ( <i>Otolithes argenteus</i> )	Tanah Abang	<i>Absidia</i> sp., <i>Asp. Awamori</i> , <i>Asp. carbonarius</i> , <i>Asp. flavus</i> *, <i>Asp. ochraceus</i> , <i>Asp. tamarii</i> , <i>Mucor circinelloides</i>
Tongkol ( <i>Euthynnus affinis</i> )	Jatinegara	<i>Asp. carbonarius</i> , <i>Asp. ochraceus</i> , <i>Chaetomium</i> sp., <i>Mucor circinelloides</i>

Note:

\* = very strong xerophilic

Table 2. The moulds isolated from dried salted fish.

Name of the fish	Sampling Location	Species Isolated
Bawal Putih ( <i>Pampus argenteus</i> )	Depok	<i>Aspergillus glaucus</i> *, <i>Asp. flavus</i> , <i>Asp. terreus</i> , <i>Neurospora</i> sp.
Belanak ( <i>Mugil cephalus</i> )	Tanjung Priok	<i>Chaetomium</i> sp., <i>Doratomyces</i> sp. <i>Moniliella</i> sp.
Belut ( <i>Fluta alba</i> )	Depok	<i>Asp. awamori</i> , <i>Asp. carbonarius</i> *, <i>Asp. ochraceus</i> , <i>Asp. oryzae</i> , <i>Eurotium amstelodami</i> , <i>Cladosporium macrocarpum</i> , <i>Penicillium chrysogenum</i> , <i>Penicillium citrinum</i>
Bulu ayam ( <i>Setipinna taty</i> )	Kebayoran Lama	<i>Asp. candidus</i> group (1), <i>Eurotium repens</i>
Cucut ( <i>Stromateus cine-reus</i> )	Depok	<i>Asp. flavus</i> , <i>Asp. oryzae</i> , <i>Cladosporium macrocarpum</i> , <i>Penicillium italicum</i> , <i>Penicillium</i> sp. (1)
Gabus ( <i>Channa striata</i> )	Kebayoran Lama	<i>Asp. ochraceus</i> , <i>Cladosporium sphaerospermum</i>
Gurame ( <i>Osphronemus goramy</i> )	Parung	<i>Asp. glaucus</i> *, <i>Asp. awamori</i>
Jambal ( <i>Pangasius pangasius</i> )	Kebayoran Lama	<i>Penicillium chrysogenum</i>
Jambrong ( <i>Therapon theraps</i> )	Parung	<i>Asp. candidus</i> group (1), <i>Ab-sidia corymbifera</i> , <i>Cladosporium sphaerospermum</i>
Japuh ( <i>Dussumieria acuta</i> )	Kebayoran Lama	<i>Asp. candidus</i> group (1), <i>Moniliella</i> sp.
Julung-Julung ( <i>Dermogeny pusillus</i> )	Kebayoran Lama	<i>Eurotium repens</i> , <i>Asp. candidus</i> group (1), <i>Chaetomium</i> sp.
Kakap ( <i>Lates calcarifer</i> )	Pasar Minggu	<i>Neurospora</i> sp.
Layang ( <i>Decapterus russelli</i> )	Kebayoran Lama	<i>Cladosporium sphaerospermum</i> , <i>Penicillium citrinum</i>
Layur ( <i>Trichiurus haunela</i> )	Kebayoran Lama	<i>Asp. awamori</i> , <i>Asp. candidus</i> group (2), <i>Chaetomium</i> sp., <i>Fusarium</i> sp., <i>Penicillium italicum</i>
Lidah ( <i>Cynoglossus lida</i> )	Tanjung Priok	<i>Asp. terreus</i> , <i>Eurotium repens</i> , <i>Moniliella</i> sp., Unidentified species
Mata Besar ( <i>Ilisha dussumieri</i> )	Ciputat	<i>Asp. flavus</i> , <i>Asp. fumigatus</i> *, <i>Asp. glaucus</i> *, <i>Asp. sydowii</i> , <i>Asp. tamarii</i> , <i>Aspergillus</i> sp.

Name of the fish	Sampling Location	Species Isolated
Nilam ( <i>Osteochilus hasselti</i> )	Parung	<i>Asp. candidus</i> group (1), <i>Asp. glaucus</i> , <i>Eurotium repens</i>
Petek ( <i>Leiognathus ruconius</i> )	Kebayoran Lama	<i>Chaetomium</i> sp., <i>Asp. tamarii</i> , <i>Asp. candidus</i> group (1)
Samge ( <i>Pseudosciaena sina</i> )	Kebayoran Lama	<i>Eurotium repens</i> *, Unidentified species
Selar ( <i>Caranx leptolepis</i> )	Depok	<i>Eurotium amstelodami</i> *, <i>Penicillium chrysogenum</i> , <i>Penicillium</i> sp. (1), <i>Penicillium</i> sp. (3)
Sepat ( <i>Trichogaster pectoralis</i> )	Kebayoran Lama	<i>Asp. candidus</i> group (1), <i>Asp. carbonarius</i> , <i>Asp. glaucus</i> , <i>Asp. sydowii</i> , Unidentified species
Talang-talang ( <i>Chorinemus lysan</i> )	Depok	<i>Asp. glaucus</i> *, <i>Penicillium citrinum</i> , <i>Penicillium italicum</i>
Tawes ( <i>Puntius gonionotus</i> )	Pasar Parung	<i>Asp. awamori</i> , <i>Asp. flavus</i> , <i>Aspergillus</i> sp., <i>Chaetomium</i> sp.
Tembakang ( <i>Helostoma teminc-kii</i> )	Pasar Minggu	<i>Asp. carbonarius</i> *, <i>Asp. tamarii</i> *, <i>Eurotium amstelodami</i>
Tembang ( <i>Sardinella fimbriata</i> )	Pasar Minggu	<i>Penicillium</i> sp. (1)
Tenggiri ( <i>Scomberomorus guttatus</i> )	Ciputat	<i>Asp. carbonarius</i> , <i>Asp. tamarii</i> , <i>Penicillium</i> sp. (1)
Teri Balang ( <i>Stolephorus</i> spp.)	Ciputat	<i>Asp. glaucus</i> , <i>Asp. ochraceus</i> , <i>Mucor circinelloides</i> , <i>Penicillium</i> sp. (1)
Teri Jengki ( <i>Stolephorus</i> spp.)	Pasar Minggu	<i>Asp. carbonarius</i> , <i>Asp. ochraceus</i> , <i>Cladosporium sphaerospermum</i> , <i>Penicillium</i> sp. (1)
Teri Medan ( <i>Stolephorus</i> spp.)	Pasar Minggu	<i>Asp. carbonarius</i> , <i>Asp. ochraceus</i> *, <i>Curvularia lunata</i> , <i>Nigrospora sphaerica</i> , <i>Penicillium</i> sp. (1), <i>Penicillium</i> sp. (2)
Tongkol ( <i>Euthynnus affinis</i> )	Pasar Parung	<i>Absidia</i> sp., <i>awamori</i> , <i>Asp. tamarii</i> , <i>Curvularia lunata</i>

Note:  
\* = very strong xerophilic

## RESULTS AND DISCUSSION

The moulds isolated from the unsalted and salted dried fish are respectively presented in Table 1 and Table 2. The genus *Aspergillus* is dominant in both kind of fish samples. The other genera found on unsalted dried fish were *Absidia*, *Chaetomium*, *Doratomyces*, *Cladosporium*, *Eurotium*, *Fusarium*, *Mucor*, *Moniliella*, *Neurospora*, *Nigrospora*, *Penicillium*, *Rhizopus*, *Scopulariopsis*, *Sordaria*, *Syncephalastrum*, and *Trichoderma*. On salted dried fish were found the genera *Absidia*, *Chaetomium*, *Cladosporium*, *Curvularia*, *Eurotium*, *Fusarium*, *Mucor*, *Neurospora*, *Nigrospora*, *Penicillium*, and unidentified species.

In this study, *Neurospora* is reported as a single species. However, this does not mean that this fungus is the sole one, because it grew so fast, even on Dichloran Agar, and did not give the opportunity of other moulds to grow.

Many among the genera found were also reported by Hocking (1991). Morohita (1988) in his review paper mentioned that *Penicillium*, *Aspergillus*, and *Mucor* are the predominant isolates in smoked squid, scallops, and cod, while in dried fish *Aspergillus*, *Chaetomium*, *Epicoccum*, *Eurotium*, *Penicillium*, and on dried "bonita stick" (fish) were found *Aspergillus ochraceus*, *Asp. oryzae*, *Asp. tamarii*, and *Syncephalastrum racemosum*.

The dominant xerophilic aspergilli in this study were *Aspergillus carbonarius*, *Asp. tamarii*, and *Asp. glaucus* which showed a good growth after 24 h of incubation at 30°C. All other isolates grew slowly after 72-96.

*Aspergillus glaucus*, *Asp. candidus*, and *Penicillium* sp. (1) were the dominant species in salted fish samples. However, the strong xerophilic were strains belonging to *Asp. awamori*, *Asp. candidus*, *Asp. carbonarius*, *Asp. glaucus*, *Asp. ochraceus*, *Asp. tamarii*, *Eurotium repens*, and *Penicillium* sp. The unidentified isolates strongly resembling *Paecilomyces* were found on three samples of salted dried fish. These isolates might probably be *Polypaecilomyces pisce*; a common species on dried salted seafoods in the tropics (Hocking, 1991). *Wallemia sebi* was not found in both kind of samples.

It is to be recommended for further study to examine the mycotoxins produced by these xerophilic moulds.

## ACKNOWLEDGEMENT

The authors would like to thank Dr. R.A. Samsom from CBS, The Netherlands, for the Dichloran Medium

and to Dr. J.I. Pitt from CSIRO, Australia, for providing the necessary references.

## REFERENCES

- Domsch, K.H., W. Gams & T.H. Anderson. 1993. Compendium of soil fungi. Volume 1. Academic Press, London.
- Ellis, M.B. 1971. Dematiaceous hyphomycetes. Commonwealth Mycological Institute, Kew, United Kingdom.
- Hocking, A.D. 1991. Isolation and identification of xerophilic fungi in stored commodities. In: Champ, B.R., E. Highley, A.D. Hocking, and J.I. Pitt (eds). Fungi and mycotoxins in stored products. Proceeding of an International Conference, Bangkok, Thailand, 23-26 April 1991.
- Moeljanto, R. 1982. Penggaraman dan pengeringan ikan. PT. Penebar Swadaya, Jakarta.
- Motohiro, T. 1988. A review of Japanese studies. In Burt J.R. (ed.) Fish smoking and drying: The effect of smoking and drying on the nutritional properties of fish. Elsevier Applied Science, London: 91-120.
- Pitt, J.I. 1979. The genus *Penicillium* and its teleomorphic states *Eupenicillium* and *Talaromyces*. Academic Press, London.
- Pitt, J.I. & A.D. Hocking. 1991. Significance of fungi in stored products. In: Champ, B.R., E. Highley, A.D. Hocking, and J.I. Pitt (eds). Proc. of an International conference. Bangkok, Thailand, 21-26 April 1991. pp. 16-31.
- Pitt, J.I. A.D. Hocking, B.F. Miscamble, O.S. Dharmaputra, K.R. Kuswanto, E.S. Rahayu, Sardjono. 1998. The mycoflora of food commodities from Indonesia. *J. Food Mycology* 1 (1), 41-60.
- Poernomo, A., E.S. Heruwati & B.S.B. Utomo. 1988. Keragaman dan program penelitian pasca panen perikanan. Badan Penelitian dan Pengembangan Perikanan, Departemen Pertanian, Jakarta.
- Poulter, R.G. 1988. Processing and storage of traditional dried and smoked fish products. In: Burt, J.R. (ed.). Fish smoking and drying. pp. 85-89. Elsevier Applied Science, London and New York.
- Raper, K.D. & D.I. Fennel. 1965. The genus *Aspergillus*. The Williams & Wilkins Co., Baltimore.
- Samsom, R.A., E. Hoekstra, J.C. Frisvad, O. Filtenborg. 1995. Introduction to food-borne fungi. Centraalbureau voor Schimmelcultures, Baarn, The Netherlands.
- Seifert, K.A. 1990. Isolation of filamentous fungi. In: Labeda, D.P. (ed.). Isolation of biotechnological organisms from nature, 21-47 pp. MacGraw-Hill Publishing Co, New York.
- Winiati, P.R., S. Maoen, Suliantri, S. Fardiaz. 1992. Teknologi fermentasi produk perikanan. Inter University Center for Food and Nutrition. Bogor Agricultural University, Bogor.