

The behavior of catfish traders on the food safety perspective in Malang Markets, Indonesia

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Abstract. Kartikaningsih H, Yahya, Setijawan D, Fathoni HI. 2022. The behavior of catfish traders on the food safety perspective in Malang Markets (Indonesia). *Biodiversitas* 23: 2270-2275. Catfish markets in Malang are supported by catfish farmers in Tulungagung regency, delivered every two days, and distributed to 37 catfish traders in 16 traditional Markets. The study aimed to understand the behavior of catfish traders in traditional markets in Malang City in terms of food safety. Our deep interviews regarding catfish disease showed that the understanding of catfish traders was the dead catfish (97.3%), the skin wound of catfish was not caused by bacteria (97.3%), unnecessary to separate unsold catfish from the new one (94.6%), not necessarily in water replacement at catfish shelter (87.5%), no sanitation of containers and equipment prior opening stalls (97.3%), no sanitizing containers and equipment with water and soap when closing stalls (18.9%) and using sanitizing work equipment to prevent bacteria contamination (0%). The guaranteed replacement of dead catfish from the supplier (100%), catfish trading knowledge from relatives (89%), elementary school background of catfish traders (81.1%), and no consumer complaints (94.6%) were fundamental things in the behavior of catfish traders in a food safety perspective. From the swab test of catfish, skin wounds were found *Aeromonas hydrophila*, *Salmonella typhosa*, and *Proteus mirabilis*.

Keywords: Bacterial disease, catfish trader behavior, food safety, Malang traditional market

INTRODUCTION

Statistical data released by the Indonesia Ministry of Maritime Affairs and Fisheries showed the increase in national catfish production has reached double, from catfish 841.75 thousand tons to 1.81 million tons in 2018. In addition, according to the data released by the Central Statistics Agency (BPS) in 2016, the number of catfish Marketed in Klojen sub-district only can reach 7500 kg/year). This figure has doubled compared to 2014 which was only 3000 kg /year). The increase in catfish production must be balanced between quality and safety because catfish have a risk of MAS disease (*Motile Aeromonas Septicaemia*) caused by the bacteria of *Aeromonas hydrophila* so that the cleanliness of catfish as a food source must be importantly considered. *Aeromonas hydrophila* is a gram-negative rod-shaped bacterium and is known to cause the most common bacterial infections in waters and cause a variety of pathological conditions (Kartikaningsih et al. 2020; Biswas et al. 2021). The bacteria is an emerging foodborne pathogen, when ingested by humans can cause gastroenteritis, and its main reservoir is the aquatic environment (Park et al. 2021).

Although foodborne outbreaks in Indonesia have not been reported yet, incidents through consumption of food contaminated with *A. hydrophila* have been reported in other countries such as China (Zhang et al. 2012). John et al. (2019) reported that the symptoms of *A. hydrophila* in humans due to consumption of contaminated food include

watery or bloody diarrhea, subacute or chronic gastroenteric syndrome, and cholera.

Infections can be sourced or derived from fish or processed foodstuffs that have previously been contaminated with *A. hydrophila*. Product processing, e.g., cooking, thoroughly can minimize the risk of bacteria transmission. However, various forms of processing may not always eliminate *A. hydrophila* contamination (Igbinosa et al. 2012). *Aeromonas hydrophila* can grow under refrigeration conditions (0-10°C) like *Listeria monocytogenes* and *Yersinia enterocolitica*. The bacteria has been isolated from various foods such as fish, seafood, vegetables, and meat (Kim et al. 2022). Granum et al. (1998) mentioned that there are three cases of disease (sepsis, meningitis, abortions) caused by consuming fermented fish containing 10⁷ CFU/g of *A. hydrophila*. In addition, Krovacek et al. (1995) revealed there are cases of disease (human intestinal pathogens) after consuming fish containing 10⁶ CFU/g of *A. hydrophila* in Sweden. In general, the disease caused by *A. hydrophila* is mostly gastroenteritis or diarrhea.

Fish that are sold dead are *halal* (an Arabic word meaning lawful or permitted). In reference to food, it is the dietary standard, as prescribed in the Qur'an (the Muslim scripture), but food ingredients should not only be halal but also must be *tayyib* (Arabic word derived from Tayyibah pl. Tayyibaat) which has extensive use and purpose in the Quran and hadith). The presence of red sores on the body of the catfish indicates that the cleanliness is not properly maintained. So far, there is an absence to understand the

critical point for the bacteria contamination in the catfish during its distribution to Malang city.

Fish health study still concerned with the disease and its treatment. Fish are halal creatures that can be consumed even though they are in the form of carcasses. Even when the cultured fish are infected with the disease and are still alive, they are still considered fresh fish, even though the bacteria present can cause disease in humans. The standard of fish freshness has not decided *A. hydrophila* bacteria as a requirement in trade circulation, although the bacteria can contaminate humans and cause stomach disease and ulcers on the hands. The critical point of the presence of *A. hydrophila* is in the catfish trade, so it is necessary to examine the knowledge level of catfish traders in terms of hygiene, health, and bacteria contamination.

MATERIALS AND METHODS

The study began with licensing arrangements at the Malang Municipal Market Service. We conducted interviews and descriptive assessments to measure the knowledge levels of hygiene, health, and bacterial contamination. The respondents were catfish traders in the city of Malang spread over five sub-districts (Figure 1). Three samples of catfish were tested for the presence of

Aeromonas hydrophila using a swabbing technique and analyzed for morphology on Rimler-Shotts (RS) Medium Base (used for selective isolation, cultivation and presumptive identification of *A. hydrophila*) and microbiological tests with the Microbach system (Mailafia et al. 2021). The study was carried out at the Microbiology Laboratory, Medical Faculty, Brawijaya University, Malang.

There are three markets in Lowokwaru sub-district, namely Tawangmangu market, Landungsari, and Dinoyo market; There are two markets in Blimbing sub-district, namely Blimbing market and Bunulrejo market; There are six markets in Klojen sub-district, namely Pasar Besar, Klojen, Oro-oro Dowo, Mergan, Talun, and Bareng; There are two markets in Sukun sub-district, namely the Gadang market and the Sukun market; and Kedungkandang sub-district, there are three markets, namely Madyopuro, Sawojajar, and Lesanpuro markets.

RESULTS AND DISCUSSION

The distribution of catfish traders in the traditional markets at Malang City and their characteristics are provided in Table 1, while traders' statements on hygiene, health, and microbial contamination are shown in Tables 2-4.

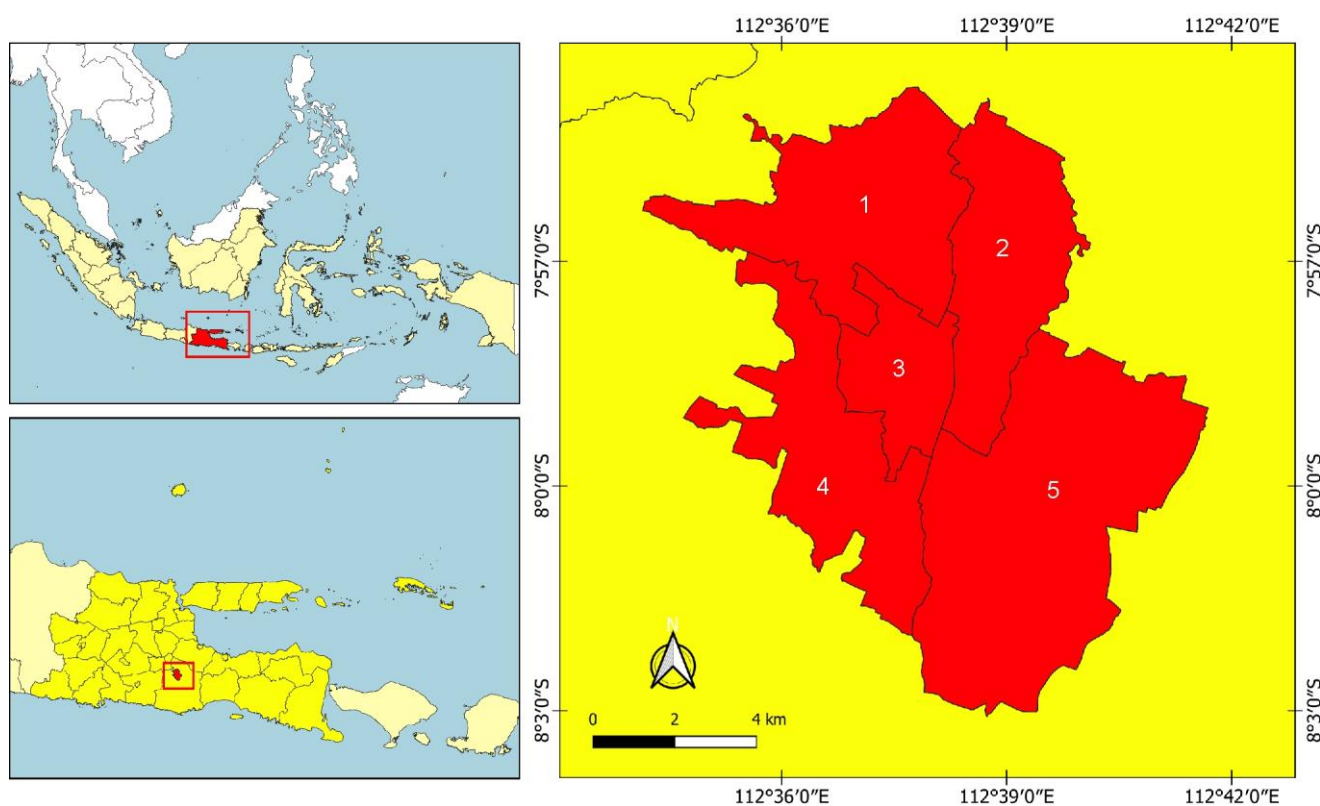


Figure 1. Malang City Map (Sampling locations are in the market in each sub-district (16 markets) (BPS, 2020). Note: 1. Lowokwaru sub-district; 2. Blimbing sub-district; 3. Klojen sub-district; 4. Sukun sub-district; 5. Kedungkandang sub-district

Table 1. Distribution of catfish traders in Malang City, Indonesia based on Market class classification

Market class	Market name	Male	Female	Total	Description
1	Pasar Besar	2	0	2	Catfish traders (no family ties)
	Blimbing	1	1	2	Husband and wife
	Tawangmangu	1	1	2	Individual catfish traders
	Klojen	0	1	1	Individual catfish traders
	Gadang	4	0	4	Family catfish traders
	Oro-oro dowo	0	2	2	Catfish traders (no family ties)
	Sukun	1	1	2	Catfish traders (no family ties)
	Madyopuro	2	0	2	Brothers catfish traders
2	Mergan	2	0	2	Catfish traders (no family ties)
	Landungsari	4	1	5	Husband and wife
	Sawojajar	5	2	7	Two pairs of husband and wife
3	Bunul	1	0	1	Catfish traders (no family ties)
	Lesanpuro	0	1	1	Catfish traders (no family ties)
	Dinoyo	1	1	2	Husband and wife
4	Bareng	1	0	1	Individual catfish traders
	Talun	1	0	1	Individual catfish traders
	Total	26	11	37	

In Malang City, markets are divided into four clusters based on their area. Several markets are not covered in this study, such as the markets of Comboran, Splendit, Embong Brantas due to no catfish traders. Also, markets that are under renovation, such as Old Gadang and Kasin are not observed. The type of spilled market, which uses the side road, and only exists in the early morning until dawn like the Kebalen market is not included in this study. Of the 16 markets observed, the high number of catfish traders was in Sawojajar market with 7 traders, while Talun, Bareng, Bunul, and Klojen had only 1 catfish trader each. Of the 37 catfish traders, there were 2 husband and wife pairs at the Sawojajar market, and 1 husband and wife pair in each Landungsari, Blimbing, and Dinoyo markets.

We recorded 37 catfish traders in Malang Big Market, in which 26 traders (70.3%) were male. Most of them came from Malang City (94.6%), Sumberpucung (2.7%), and Madura (2.7%). All traders belong to the category of the younger generation according to WHO, under 60 years and above 20 years. The youngest trader was 21 years old in Mergan market, while the oldest was 59 years old in Klojen market.

The traders mostly graduated from elementary school (81.1%), and some of them even have not finished elementary school (10.8%). The highest education levels were High School (1 person), and Vocational High School (2 persons). They gained knowledge of catfish trading mostly from parents and relatives. For example, big traders taught their children to follow in their footsteps, as can be seen in the Dinoyo integrated market. The children only have junior high school education. Another example from groups of relatives who dominated catfish trading can be seen in the Oro-oro dowo market. There were also traders who gained knowledge from their employees (10.8%). Sometimes capital owners rarely pay attention to their employees who trade catfish. These respondents belong to the lowest class of catfish traders, which are commonly under 5 years of experience. The longest experience ranged from 11 to 15 years (27.0%). However, there were also traders who sell catfish for more than 30 years in Malang

Big market and Tawangmangu market.

After the selling activity ends, all respondents cleaned up their stalls with water and soap, except respondents in the Gadang market and the Malang Big market. They just flushed the stalls with water without soap. All respondents did not clean the stalls with disinfectant, they are fear about disinfectant contamination to catfish. During the Covid 19 pandemic, spraying should be carried out by the traders in turns every three months, but we found the fact that spraying was only carried out at the beginning of the Covid 19 pandemic, after October 2020, no more disinfectant was sprayed.

All respondents cleaned their hands with water after serving customers, but only traders in Blimbing market and Mergan market did it in running water. Other respondents cleaned their hands in a small tub filled with water. Before trading activity started, the scales were washed by the traders, and it only happened to our respondents at the Blimbing market. Generally, respondents stated that the scales are washed with soap only if contain mucus and are sticky. In terms of cleanliness, the Gadang market was the most concerning, traders have no attention to the condition of the equipment before and after use, only pouring it with water, and not using running tap water. Our study documented that the scales used by respondents in the Gadang market look very rusty. Among others, Blimbing market is better, where the selling table is cleaned before starting selling activities. After all activities end, the traders clean the table, but spraying is not carried out with sprinkling water. All the waste bins are open, which leads to the arrival of flies. However, these wastes are taken up by duck farmers.

During the Covid-19 pandemic, most of the trader wear masks, but the traders in Malang Big Market and Gadang market often put masks on their chins, so that we considered our respondents not to be wearing masks. From the interview, it was known that before the Covid 19 pandemic, traders did not wear masks. Masks should be used to protect the oral cavity from microbial contamination that may occur in catfish sold. The habit of

carelessly spitting is not done, so this behavior is a kind of self-protection because wasted saliva can contaminate catfish which may be released from the tub and on the market floor. Washing hands from the bathroom cannot be proven, our respondents said that they wash their hands after using the bathroom, without using soap. The observed soap was in the form of liquid which is commonly used for washing dishes. Absences due to illness were also intended but limited to three days. The need of making money for the family is more important than themselves. We found an awareness not to smoke while selling fish is also a positive thing that respondents did. Respondents in the Landungsari market smoke after work, or during a break, they do not smoke close to the catfish sold, except respondents in the Gadang market and Malang Big market.

Most of the respondents wear an apron, except respondents from the Gadang market, but all of them admitted that they only have one apron, which is used when selling catfish. The apron remains in the stall after the trading activity ends, except respondents of Blimbing market who have a replacement apron. The use of gloves was only done by respondents in the Blimbing market. From the interviews, our respondents mentioned that gloves are considered a hassle when they work. The same goes for long nails. The habit of washing hands when returning a buyer's money is carried out by all traders, but only traders in the Blimbing and Mergan markets use running water. Other traders use water in a small plastic tub. A bad habit is to wipe hands with an apron when returning the change, also after washing hands in a small tub of water. Not all catfish traders use boots, as happened in Gadang market, Malang Big market, and Talun market. From the interview, our respondents stated that wearing boots means additional cost for them. The basic principle of traders, as long as they are not sick and feeling cold, it is enough to wear a t-shirt, shorts, and flip-flops.

Catfish traders in Blimbing market and Lesanpuro market have adequate fish storage facilities, in plastic tub containers, there is also an aerator and the water is changed every day. The traders in Lesanpuro market have catfish ponds, the unsold catfish are returned to the pond. The traders sell small catfish, which is suit for the demand of the restaurants. Generally, fish markets build a fish tank made of concrete with ceramics, but some are without ceramics (Klojen, Lesanpuro). If the market service is not provided, the catfish are accommodated in an aquarium or basin. In open markets such as the Gadang market, catfish traders have tents, catfish are placed in high-density aquariums, and water changes are rarely carried out. Water changes are carried out once a week, or if smelling fishy.

The unsold catfish are not mixed with the catfish that come later in the same container, except the catfish traders at the Lesanpuro market which has a catfish pond. In terms of size, catfish are also not separated, except for traders in the Blimbing market and Lesanpuro. They have consumption-sized catfish customers, so what is sold is mostly the consumption-sized catfish. Only catfish traders at the Lesanpuro market know that their product may have bacteria contamination. From our in-depth interview, the traders were actually able to explain the signs of catfish being contaminated by *A. hydrophila*. The traders' understanding of unhealthy catfish is a dead fish. The presence of wounds, red abscesses on the catfish's skin are supposed due to a "fight" among catfish or being hit by a sharp catfish barbell, and no one separates the catfish stock from yesterday and the one that just arrived, but all traders separate dead catfish because the supplier will replace them the same if the dead catfish is a maximum of 2 kg. If it is more than 2 kg, a loss-sharing system is applied. There are also traders who sell dead catfish which happened at the Mergan market.

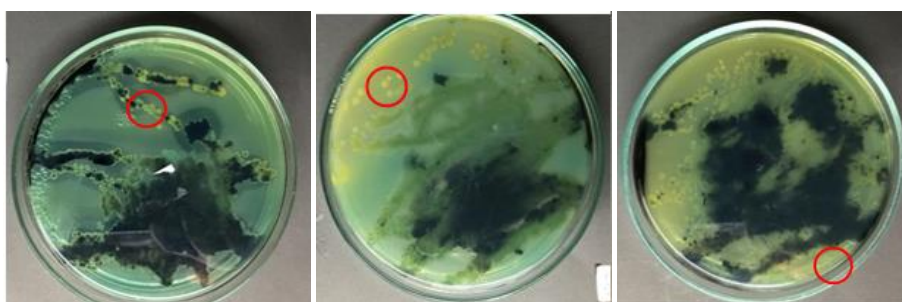


Figure 2. The results of catfish skin using swab test suspected to have *Aeromonas hydrophila* on Rimler Shotts (RS) Medium. The red mark is the colony of bacteria that will be further tested for identification

Table 2. Colony characteristics on TSA media

Parameter	LK2A	LK2B	LK3A	LK3B	LG3A	LG3B
Colony color	pale	Pale	pale	pale	pale	pale
Colony diameter	2.06mm	2.16mm	3.03mm	2.21mm	2.03mm	1.47mm
Colony form	Round	Round	round	Round	Round	round
Colony edge	flat	Flat	Flat	flat	flat	flat
Colony elevation	Convex	Convex	Convex	Convex	convex	Convex
Colony consistency	Wet	Wet	wet	wet	Wet	Wet

Table 3. Colony biochemical characteristics

Parameter	LK2A	LK2B	LK3A	LK3B	LG3A	LG3B
Colony color in TSA	Pale	Pale	Pale	Pale	Pale	Pale
Colony diameter (mm)	2.06	2.16	3.03	2.21	2.03	1.47
Gram reaction	Negative	Negative	Negative	Negative	Negative	Negative
Cell shape	Basil	Basil	Basil	Basil	Basil	Basil
Motility	Motile	Motile	Motile	Motile	Motile	Motile
Oxidase	Negative	Negative	Negative	Negative	Negative	Negative
Catalase	Negative	Negative	Negative	Negative	Negative	Negative
Indole production	Positive	Positive	Negative	Positive	Positive	Positive
Use of carbon from citrate	Negative	Positive	Negative	Positive	Positive	Negative
TSIA test	As/As,G- H ₂ S+	Alk/As,G- H ₂ S+	As/As,G- H ₂ S+	Alk/As,G- H ₂ S+	As/As,G- H ₂ S+	Alk/As,G- H ₂ S+
VP	Negative	Positive	Negative	Positive	Negative	Positive

Notes: As/As: fermented glucose and lactose or sucrose; Alk/As: fermented lactose or sucrose; Alk/Alk: unfermented sugar

Table 4. Microbact system test

Code	Result
LK2A	<i>Aeromonas hydrophila</i>
LK2B	<i>Edwardsiella tarda</i>
LK3A	<i>Salmonella typhi</i>
LK3B	<i>Salmonella typhi</i>
LG3A	<i>Aeromonas hydrophila</i>
LG3B	<i>Proteus mirabilis</i>

Discussion

The first critical point of *A. hydrophila* contamination found in this study was in the temporary storage of catfish before being sold. A supplier from Tulungagung regency sends catfish to the markets, e.g., Gadang and Blimbing, in Malang city every two days as much as 120 kg. The unsold catfish will be added to the catfish that come later without changing the water. Water change is sometimes done once a week or if a strong fishy smell occurs.

The second critical point was the understanding of catfish traders that unhealthy fish exposed to bacteria are dead fish. There is a guarantee from the supplier that the dead catfish will be replaced with healthy catfish up to 2 kg, the rest will be in the form of mutual compensation. All catfish traders know that catfish are cannibals, it can be seen from their teeth that catfish are omnivores, but these fish can be stressed by heat, high density, and poor maintenance quality. Temporary reservoirs with high density and mixing of newly arrived with previously unsold resulted in stress, so that skin marks occur due to catfish cannibalism.

The third critical point was the notion of fresh catfish. The catfish for sale is still alive, and traders consider all catfish are fresh, which is unlikely to be exposed to bacteria contamination. Indications of trading tend to be arbitrary, such as what happened in the Gadang market and the Malang Big market illustrated that the traders believe that their product is healthy fish, not dead. There are also catfish traders who sell dead catfish, mainly due to economic factors. Traders understand, dead catfish will quickly secrete mucus. The presence of dead catfish is sometimes sold to low-income consumers at low prices.

The fourth critical point is the consumer. Catfish traders in Lesanpuro market and Blimbing market mostly have regular customers, e.g., restaurants. From these consumers, catfish traders learn about the cleanliness tests as shown in Tables 2-4. This requirement gradually changed the habits of other catfish traders. For example, catfish traders at Pasar Gadang are confident that their products are still selling well even though the consumers are not from restaurants, so traders cannot learn from consumers, resulting in no standards for implementing hygienic sanitation. Habits in behavioral patterns are usually accompanied by a cognitive orientation that has been carried out for a long time so that they pay less attention to new information, in other words, individuals tend to behave as they usually do (Verplanken and Aarts 1999). This phenomenon can be seen in the behavior of catfish traders in Malang City, i.e., low educational background, very confidence that catfish can be sold-out and dead fish will be replaced by suppliers, understanding that unhealthy catfish is dead fish, ignorance of bacterial contamination that can be transmitted to consumers. Ku and Lee (2000) mentioned that the low level of knowledge of unhealthy catfish exposed to bacteria causes traders not to do the special treatment on the catfish that they sell, such as changing water, separating catfish that have signs of illness, and not selling unhealthy catfish.

The use of masks, aprons, and rubber boots is primarily for individuals. The aprons used in the market seem not been replaced in a long time, which indicates that clothes, hands, hair, and nails are sources of contaminants. The use of masks is carried out during the Covid-19 pandemic. However, they know that the disinfectant may poison the catfish so that the stalls, containers, plates, and knives are not cleaned with disinfectant.

The results of the swab test on the skin wounds showed that the catfish were contaminated with *A. hydrophila* and *Salmonella typhosa*. *Aeromonas* is indigenous bacteria, present in the rearing water and will attack catfish when they are hungry, stressed, and kept in high-density containers. *Salmonella typhosa* is a bacterial contaminant that causes bloody diarrhea. The presence of *Salmonella typhosa* can be caused by containers, water, or other contaminants.

In conclusion, the critical points of *A. hydrophila* contamination are mixing stocks of unsold catfish with newly arrived, replacing water in catfish holding tanks once a week, high catfish density, not separating catfish with signs of bacterial diseases, and healthy ones. Understanding of catfish traders is sick catfish means dead catfish. The application of improved sanitation and hygiene is mainly intended for the health of traders.

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