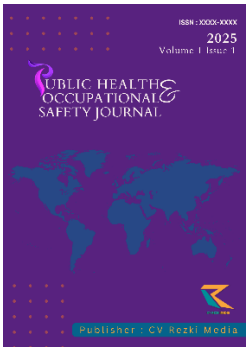

Effectiveness of fly traps with a variety of baits on the number of flies trapped in the primary market among farmers in Batu city

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ABSTRACT

Background: Diarrhea is one of the top ten diseases in Batu City. One of the vectors causing this disease is flies, often found in traditional market environments. Fly control efforts can be carried out using traps combined with various types of bait, but the effectiveness of trap and bait variations has not been systematically studied.

Objectives: This study aims to determine the effectiveness of fly traps with various baits on the number of flies trapped in Among Tani Main Market, Batu City.

Methods: This study used a quasi-experimental design with a posttest-only group design. The variables observed were the number of flies trapped in three types of traps (bottles, nets, and blocks) and three variations of bait (shrimp, fish gills, and chicken offal). Traps were deployed for two hours per day over three consecutive days, with each treatment repeated three times. The instruments used were modified fly traps and laboratory inventory. Data were analyzed using Levene's test for homogeneity and one-way ANOVA to determine differences between treatments.

Results: ANOVA test results showed no significant difference ($p > 0.05$) between bait and types of traps in the number of flies trapped. However, bottle traps with fish gill bait showed the highest number of catches based on descriptive analysis. (395 flies over three days).

Conclusions: Although there was no statistically significant difference, the bottle trap with fish gill bait was descriptively the most effective at catching flies. This study suggests using bottle traps with fish gill bait as an alternative to fly control in the market environment. Further research is recommended to examine the effect of environmental conditions and types of fly species on the effectiveness of traps and baits.

Keywords: bait, flies, fly traps, traditional markets, vector control.

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INTRODUCTION

Flies are pests and nuisance animals that can harm humans. Flies are known vectors of several diseases, including cholera, dysentery, typhoid, and diarrhea. We can encounter several types of flies in everyday life, such as small, house, green, and so on (Arif & Lestari, 2019; Daramusseng et al., 2021; Harnani et al., 2021). Improving environmental hygiene and sanitation can be more effective and have more long-term benefits in fly management efforts. Efforts to improve environmental hygiene and sanitation can be made by reducing or eliminating fly reproduction sites, breeding grounds, or other sources that can attract flies. They can also reduce contact with flies by protecting or protecting food (Nadeak et al., 2021). According to Garmini and Purnama (2019), flies have a life cycle that starts from the development of eggs to adulthood, which only takes 10-12 days. Flies are also animals that can reproduce very quickly. A reasonably fast fly life cycle makes flies difficult to destroy and can only be controlled with limits that are not dangerous or cause health problems (Lestari et al., 2020; Wulandari, 2018).

A study conducted in Medan showed that the use of fly traps is an effective way to reduce fly density. The study showed a substantial decrease in fly density from the density level of 42.31% to 0.00% and from 46.15% to 30.77% (Tanjung, 2017). In the same study, it was also known that the use of various types of bait variations such as fish gills, bagasse, and shrimp in fly traps was also an effective way in fly control efforts, as evidenced by the flies obtained respectively 353 tails, 518 tails and 245 tails (Tanjung, 2017). Similar research has been conducted using bottle traps with several bait variations. The bait variations used were shrimp bait, bagasse bait, and fish waste bait. In this study, it was found that the type of fish waste bait was the type of bait favored by flies as evidenced by the results of flies trapped in 5 days, namely 204, 179, 116, 110, and 79, with an average of 141 trapped flies (Pandaitan & Sambuaga, 2019). Several other studies show the same results, which prove that fish waste is a favorite bait for trapping flies in Fly Trap or traps rather than other baits (Ahmad et al., 2020; Saipin et al., 2019; Savitriani & Maftukhah, 2021).

According to data from the Central Statistics Agency (BPS, 2020) of Batu City in 2019, diarrhea is among the top 10 diseases in Batu City. Fly control can be one of the efforts that can be done in order to implement clean and healthy living behavior (PHBS) as an effort to reduce diarrheal disease. One of the efforts in controlling fly density is to reduce flies using fly or fly traps.

Although various housefly (Musca domestica) control methods have been developed, most previous studies have focused on the effectiveness of one type of bait or trap in isolation. For example, Nadeak et al. (2021) evaluated the effectiveness of various baits in fly traps and found that shrimp bait was most effective compared to fermented chili peppers and rotten tomatoes. However, the study did not examine the combination of different types of traps with bait variations in a traditional market environment with high human activity. In addition, the use of synthetic insecticides for housefly control often leads to resistance and negative impacts on the environment. Therefore, research integrating different traps and natural animal protein-based baits is needed to develop more effective and environmentally friendly fly control strategies in traditional market environments.

Therefore, this study aimed to find types of traps and bait variations that are effectively used to attract and trap flies into the trap. Based on several studies that have been conducted, various uses of bait variations in fly traps can be used to reduce

fly populations. With a wide variety of traps and baits, this study aims to determine the effectiveness of fly traps using a variety of baits at the Central Market in Tani Batu City.

This study offers a new approach to housefly (Musca domestica) control in traditional market environments by testing the effectiveness of a combination of traps and animal protein-based natural baits. Previous studies have generally focused on the effectiveness of one type of bait or trap separately. For example, the study by Sruthi et al. (2022) evaluated the attractiveness of various protein baits to fruit flies in agricultural fields. However, it did not examine the combination of baits and traps in a market environment with high human activity. Similarly, the study by Maung et al. (2019) developed a protein-based bait formulation to attract fruit flies in Myanmar but has not tested its effectiveness in a traditional market context. By combining three types of traps (bottles, nets, and blocks) and three types of natural baits (shrimp, fish gills, and chicken offal) in a dense traditional market environment, this study makes a novel contribution to an applicable and environmentally friendly fly vector control strategy.

METHODS

Study Design and Participants

The research method in this study used a type of quasi-experimental research or experiment that was carried out to determine the effectiveness of several variations of fly traps with three treatments: bait variations, including shrimp, fish gills, and chicken offal. The design of this research is a posttest-only group design. In this study, the unit of analysis sought was the number of flies trapped, which was calculated within two hours in three days with three repetitions. After that, the data were grouped based on the type of trap and bait variation.

Ethical approval statement

This study did not involve human subjects or experimental animals directly. All procedures have been carried out by work safety rules and do not require approval from the ethics committee.

Research Instruments

The fly traps used in this study are bottle, net, and block traps. Bottle traps can be obtained by using materials from used bottles that have been modified to trap flies, and flies can enter and be trapped; net traps are obtained by purchasing and using the inventory of the State University of Malang Environmental Health Laboratory, as well as block traps were constructed using materials from the Environmental Health Laboratory inventory at the State University of Malang. The traps were installed at market stations representing areas with fish and meat selling activities. The traps were pre-tested to ensure optimal functioning during observation.

Data Analysis

Levene's Test was used to test the homogeneity of the data. Furthermore, to determine whether there is a significant difference between the treatment groups, a one-way Analysis of Variance (ANOVA) Test was conducted. If a significant difference was found, a post hoc test using the Tukey method was followed to determine which pair of groups showed a significant difference. All analyses were performed with a significance level of 5% ($\alpha = 0.05$) using statistical software.

RESULTS

Research to test the effectiveness of fly traps with various baits was conducted at the Among Tani Central Market in Batu City, located in Temas Village, Batu District, Batu City, which is a traditional market managed in a modern manner. There are three stages of the process carried out in this research. The first stage of the process will be carried out by placing three types of traps, each totaling three traps using three variations of bait. The types of traps used are bottle, net, and block traps. The bait variations used are shrimp bait, fish gills, and chicken offal. The traps were placed at the waste management site (TPS) of Central Market, where data on the number of flies caught was obtained by setting the traps for two hours. Phase II was repeated by setting traps and bait variations the next day after setting the first trap. Phase III was conducted by repeating the study on the next day after laying the types of traps and bait variations in the second phase or second repetition.

Table 1. Number of Flies Trapped on the First Day by Trap Type and Bait Variation at the TPS of Central Market, Among Tani, Batu City

	Control	Shrimp	Fish Gills	Chicken Offal
Bottle Trap	0	44	148	114
Net Trap	0	19	46	35
Block Trap	0	18	22	13

Based on the results obtained in Table 1, it is known that on the first day of data collection, bottle traps with fish gill bait at the Central Market Waste Processing Site (TPS) contained the most flies. The number of flies in the bottle trap with fish gill bait resulted in 148 flies being trapped.

Table 2. Number of Flies Trapped on the Second Day by Trap Type and Bait Variation at the TPS of Central Market, Among Tani, Batu City

	Control	Shrimp	Fish Gills	Chicken Offal
Bottle Trap	0	53	121	96
Net Trap	0	31	58	47
Block Trap	0	23	27	18

Based on the results obtained in Table 2, it is known that on the second day of data collection, the bottle trap with fish gill bait contained the most flies. The number of flies in the bottle trap with fish gill bait amounted to 121.

Table 3. Number of Flies Trapped on the Third Day by Trap Type and Bait Variation at the TPS of Central Market, Among Tani, Batu City

	Control	Shrimp	Fish Gills	Chicken Offal
Bottle Trap	0	50	126	78
Net Trap	0	14	11	6
Block Trap	0	7	14	11

Based on the results obtained in Table 3, it is known that on the third day of data collection, the bottle trap with fish gill bait at the TPS of the Central Market contained the most flies. The number of flies contained in the bottle trap with fish gill bait amounted to 126. The total catch is listed in Table 4 below.

Table 4. Recapitulation of the Total Number of Flies Trapped Over Three Days Based on the Combination of Trap Types and Bait Variations at the TPS of Central Market, Among Tani, Batu City

	First Day	Second Day	Third Day	Total
Bottle Trap – Shrimp Bait	44	53	50	147
Bottle Trap – Shrimp Bait	148	121	126	395
Bottle Trap – Chicken Offal Bait	114	96	78	288
Net Trap – Shrimp Bait	19	31	14	64
Net Trap – Fish Gill Bait	46	58	11	115
Net Trap – Chicken Offal Bait	35	47	6	88
Block Trap – Shrimp Bait	18	23	7	48
Block Trap – Fish Gill Bait	22	27	14	63
Block Trap – Chicken Offal Bait	13	18	11	42

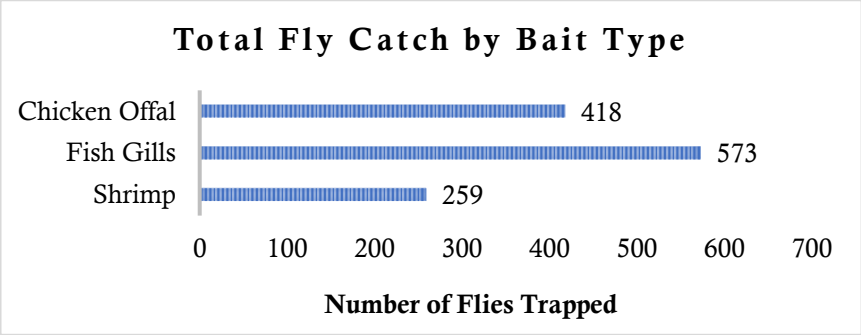

Figure 1. Total Number of Flies Caught by Bait Type at the TPS of Central Market, Among Tani, Batu City

Based on the results of data analysis in Table 4, it is known that the bottle trap with fish gill bait is the type of trap variation and bait variation that is most favored by flies so that flies are attracted to enter the trap. In this case, it is supported by the data obtained in the form of the number of flies trapped in the bottle trap with fish gill bait, which is 148 flies, then the net trap with fish gill bait is 58 flies, and the Block Trap with fish gill bait is 27 flies. Referring to Figure 1, fish gills are the type of bait that traps the most flies (573 flies). Data from descriptive analysis can be seen in Table 5.

The results obtained from the ANOVA test were F = 0.477 and sig = 0.626. In these results, means $p>0.05$, which proves there is no significant difference in the number of flies trapped in each trap using various bait types. The results of the ANOVA test can be seen in Table 6.

Table 5. Descriptive Analysis Results of the Number of Flies Trapped at the Central Market TPS, Among Tani, Batu City, Based on Trap and Bait Variations

Types of Traps and Baits	n	Mean	Standard deviation	Standard error	95 % Confidence Interval For Mean		Min	Max
					Lower bound	Upper bound		
Bottle Trap	9	92.2	37.78	12.59	63.18	121.26	44	148
Net Trap	9	29.7	18.26	6.087	15.63	43.70	6	58
Block Trap	9	17.0	6.36	2.12	12.11	21.89	7	27

Table 6. ANOVA Test Results of the Number of Flies Trapped at the Central Market, Among Tani, Batu City

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1668.074	2	834.037	.477	.626
Within Groups	41937.556	24	1747.398		
Total	43605.630	26			

DISCUSSION

The results showed that the bottle trap with fish gill bait descriptively was the most effective combination in catching flies, with a total catch of 395 flies over three days. Although the ANOVA test results did not show statistically significant differences between bait and types of traps ($p > 0.05$), the descriptive data showed that specific bait and trap shapes attracted more flies. These findings are consistent with previous research by Saipin et al. (2019), which showed that flies are more attracted to fish waste-based baits due to their strong aroma and high protein content. Research by Pandaitan and Sambuaga (2019) also supports these results, where fish waste bait types produced the highest number of fly catches compared to other bait types. This suggests that fish gills, as part of fish waste, have great potential as bait material in fly control in the market environment.

Flies are attracted to strong odors and white surfaces. Flies have a sense of smell on the antennae and palpus; flies have highly sensitive olfactory organs that it can smell weak odors, volatile substances, and fermented foods. Fish gill bait is the most favored bait by flies because flies eat foods eaten by humans, such as protein, sugar, milk, and others; besides that, flies also like to eat foods that are in the process of fermentation or decay. Flies tend to like wet food, while dry food will be moistened first with their saliva and then sucked (Saipin et al., 2019). The shrimp bait variation is also one of the effective bait variations used to trap flies. Shrimp bait succeeds in making many flies because it has a distinctive aroma and also the aroma of feces located on the head. In addition, the content of fatty acid protein sources in shrimp is also attractive to trapping flies in the trap (Saipin et al., 2019). Chicken offal bait is also one of the effective baits that can be used to catch flies because chicken offal has a very pungent odor and tends to be favored by flies (Hadi et al., 2022).

After obtaining data and testing the data that has been obtained, it can be seen that there is no significant difference in the type of trap variation and bait variation used at the Central Market in Tani Batu City. However, descriptively, the bottle trap is more capable of trapping flies in the trap than the net and block trap. The fish gill bait is more favored by flies than shrimp bait and chicken offal, so flies are attracted and enter the trap. Market and environmental conditions can influence the types of flies that enter the trap (Andiarsa, 2018; Munandar et al., 2018). Fruit and green flies are traditional markets' most common fly species (Sebayang & Sinaga, 2021). The type of merchandise provided can also be one of the factors affecting fly diversity (Rahayu et al., 2019; Rahim et al., 2020). In the fishmonger sector, which provides much fish, more houseflies were found than other types of flies (Fadhila et al., 2022).

After learning the research results, we noticed differences in results from some research on fly traps and bait variations that have been done before. Previous research states that chicken offal is a variation of bait that flies prefer to enter the trap compared to several other types of bait variations (Hadi et al., 2022). Different results from this study were also obtained in a study that stated that flies favored shrimp bait

variations to lure flies into the trap compared to several other bait variations (Firiana Eva & Mulasari, 2021). Different results were also obtained in this study, showing that fish gill bait was more favored to attract flies into the trap than chicken offal bait and shrimp bait. Based on the results obtained, it is also known that Fish gill bait has strong potential to attract flies into traps due to its distinct odor and rapid decay if used as bait in the installation of these types of traps to trap flies. One thing that supports fish gills as a potential bait is the nature of fish, which has a decaying process that can be considered fast. This is supported by fish with a very high-water content; therefore, fish can quickly decay. Flies are also attracted to fish gills because they contain blood and emit a distinctive, pungent odor. With the nature of flies, which are like liquid food or wet food, fish gills become the bait that is arguably favored by flies (Saipin et al., 2019).

Similar results were obtained in this study, in line with the results of previous studies, which also mentioned variations of fish gill bait as a potential and effective bait variation because it is favored by flies to attract flies into the trap (Saipin et al., 2019) and also in line with the research of Panditan and Sambuaga (2019) which mentioned the type of fly trap with fish waste bait was the most effective in attracting flies.

Many things can influence flies to enter the trap using the bait provided. Apart from the characteristics of the bait variations, the high density of flies can affect the number of flies trapped. External factors can affect the number of flies trapped in the trap. These factors are the availability of food for flies in the TPS environment and the cleaning of the TPS. Both of these have a relationship to the number of flies in a place; when the availability of food for flies tends to be a lot, the number of flies in a location will be higher, and also when the level of cleaning of the TPS at that location is pretty minimal, the fly population at that location will also be high (Marisdayana & Hermawan, 2022). This will affect the number of flies that can enter and be trapped, the higher the number of fly density, the higher the number of flies trapped.

This study's results indicate that bottle traps with fish gill bait are descriptively more effective in trapping flies. This finding can be a reference for market managers, sanitation officers, and public health agencies to use alternative traps that are more economical and environmentally friendly in controlling fly populations in traditional market temporary disposal sites (TPS). This finding supports promotive and preventive efforts in the Clean and Healthy Living Behavior (PHBS) program, especially in reducing the risk of vector-based diseases such as diarrhea, typhoid, and cholera, which are closely related to the presence of flies. This study opens opportunities for developing fly trap products based on local materials that can be mass-produced and adapted to the characteristics of a particular market or environment.

Limitations of the study

However, this study was only conducted for three days and focused on one market location (TPS Central Market, In Tani Batu City). The results may not be generalizable to other market areas with different environmental conditions, such as cleanliness, type of waste, and humidity. This study did not classify or identify the species of flies caught. Each species has a different preference for the type of bait, so the data can be more in-depth if combined with entomological identification.

CONCLUSIONS

Based on the study results, there was no statistically significant difference between bait and trap variations. However, descriptive analysis indicated that bottle traps were the most effective, particularly when combined with fish gill bait, which attracted the highest number of flies. The preference for bait may be influenced by environmental conditions within the market area. Overall, fly trapping—especially using bottle traps with fish gill bait—has demonstrated practical potential as an effective method for controlling fly populations.

DATA AVAILABILITY

The data underlying the findings in this article were obtained through direct observation in the field and have been documented by the researcher. The data is not publicly available but can be provided by the author of the correspondence upon reasonable request.

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CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest in conducting this research or in preparing this scientific article.

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