Journal of Entomology and Zoology Studies
Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(3): 571-574

Received: 16-03-2020
Accepted: 18-04-2020

Md. Fazlul Haque
Associate Professor, Department of Zoology, University of Rajshahi, Rajshai-6205, Bangladesh

Sabina Sultana
Professor, Department of Zoology, University of Rajshahi, Rajshai-6205, Bangladesh

Moni Krishno Mohanta
Associate Professor
Department of Zoology, University of Rajshahi, Rajshai-6205, Bangladesh

Md. Ariful Hasan
Professor, Department of Zoology, University of Rajshahi, Rajshai-6205, Bangladesh

Corresponding Author:
Md. Fazlul Haque
Associate Professor, Department of Zoology, University of Rajshahi, Rajshai-6205, Bangladesh

Observation on the avoidance of fruits and fish by flies: An alternative approach for detection of formalin contamination

Md. Fazlul Haque, Sabina Sultana, Moni Krishno Mohanta and Md. Ariful Hasan

Abstract
Formalin, a carcinogenic agent, is illegally used for preservation of fruits and fishes in Bangladesh. It is often observed that flies are avoiding some fruits and fishes for an unknown reason in fruits and fish markets. Therefore, it was assumed that flies may avoid the contaminated fruits and fishes by detection of presence of formalin in those items. Hence, this study was designed to uncover relationship between rate of avoidance of the fishes by flies and the concentration of formalin for contamination. For this study, five types of fruits *viz.* Mango, Orange, Apple, Papaya and Banana, and two types of fishes, *viz.* Puthi, *Puntius titus* (Hamilton, 1822) and Tilapia, *Oreochromis niloticus* were soaked with normal water (Control) and 120 ppm, 250ppm, 500ppm, 750ppm, 1000ppm and 2000ppm solution of formaldehyde for 1 minute. Then fruits and fishes were kept in different Petridis separately in open place for 1 hour to count the flies available on fruits and fishes. Finally, the counted number was analyzed with Graph Pad Prism software. It was found that number of flies in all samples of fruits and fishes was decreased gradually from the lowest concentration of formalin (250ppm) to the higher concentration indicating that flies can detect the presence of formalin in fruits and fishes even in the lowest concentration (250 ppm). However, the initial concentration of formalin which was significantly avoided by flies was different for different types of fruits and fishes. Altogether, it can be concluded that formalin contamination is one of the reasons of avoidance of fruits and fishes by flies.

Keywords: Contamination, formalin, formaldehyde, fruits, fish

Introduction
40% solution of formaldehyde in water, known as formalin, is used as a disinfectant, preservative for biological specimens and in medicine [1, 2, 3]. But, formaldehyde are notorious for its adverse effect on human health such as burning sensations in the eyes, nose and throat, coughing, wheezing, nausea and skin irritation. Most importantly, formaldehyde are reported as a carcinogenic agent [4] which is known to increase mortality from nasopharyngeal cancer [5]. However, effect of formaldehyde on human health differs individually based on age and health condition [2]. People with pre-existing respiratory problems or other chronic illness are more sensitive to formaldehyde exposure [6].

In some countries like Bangladesh, foods are illegally treated with formaldehyde for preservation. Hence, it is essential to have a method for the detection and monitoring of the level of formaldehyde in food. There are several types of conventional colorimetric methods [7, 8] for the qualitative and quantitative analyses of formaldehyde in food. For the detection of formaldehyde misuse in seafood, pulsed amperometric method and electronic nose method are used as alternatives to the conventional methods [9, 10]. However, most of these methods are time consuming or expensive or require sensitive instrument or expertise. Therefore, a simple observational way of determination of formalin contamination in foods is required for a quick decision on purchase of fruits and fishes in daily life. Different types of flies which are reported to show some degree of sensitivity to chemical [11] are commonly found in open market of fruits and fishes in Bangladesh. Hence, our hypothesis was that there might be a relationship between avoidance of the fruits and fishes by flies and the level of contamination of those fruits and fishes by formalin. Therefore, depending on the response of flies to formalin contamination, the present study was aimed to explore a simple observational way to generate a primary idea that the observed fruits and fish could be contaminated with formalin or not.

Materials and Methods

At first stock solution was prepared by adding 10mL formalin in 2000mL distilled water. Then, 120 ppm, 250ppm, 500ppm, 750ppm, 1000ppm and 2000ppm solution of formaldehyde was prepared by adding required distilled water. Then, the different types of fruits and fishes were soaked in prepared solution. In this study, five types of fruits *viz*. Mango, Orange, Apple, Papaya and Banana, and two types of fishes, *viz.* Puthi, *Puntius titus* (Hamilton, 1822) and Tilapia, *Oreochromis niloticus* were used for experiments. For each experiment with different fruits and fishes, one piece of fruit and fish was soaked in pure distilled water (Formalin free) which was used as control sample. Then, the formalin treated and control fruits and fishes were kept in different Petridis separately in open place for 1 hour to attract flies. During this time, the fruits and fishes were observed carefully to count the numbers of flies sat on the different sample of fruits and fishes. Finally the counted number was recorded and analyzed with Graph Pad Prism software. Same experiment was replicated for three times in different days.

Results

In this study, it was found that number of flies in all studied fruits and fishes was decreased gradually from the lowest concentration of formalin (120 ppm) to the higher concentration (2000 ppm) indicating that flies can detect the presence of formalin in fruits and fishes (Fig. 1 and 2, and Table 1 and 2). However, number of flies on different fruits and fishes for different concentration of formalin was varied remarkably (Table 1 and 2).

Among the treated fruits, the highest number of flies was observed on fruits treated with 120 ppm formalin while the lowest number of flies was observed on fruits treated with 2000 ppm formalin (Fig. 1 and Table 1). The number of flies on 120 ppm formalin treated fruits was lower than the number of flies on control fruits, but the differences was statistically insignificant (Fig 1). However, this difference was statistically significant for fruits treated with ≥250 ppm formalin (Fig. 1).

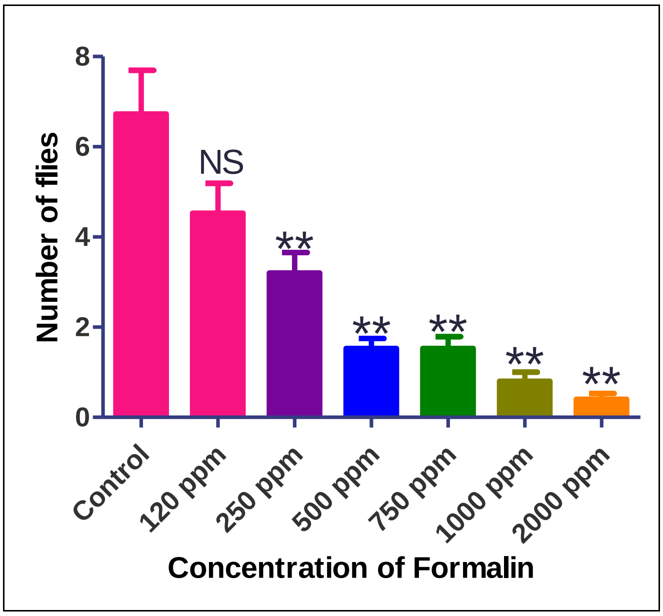

Fig 1: Effect of formalin on number of flies on fruits (Number ± SE). P value was calculated with t-test. For P value, all treatments were relative to control. Here, $^{**}P<0.01$, $^{*}P<0.05$, $^{NS}P\geq0.05$.

It was found that the number of flies varied with types of fruits. The highest number of flies was recorded on Orange while the lowest number was recorded on Apple (Table 1). Likewise, the lowest concentration of formalin which showed statistically significant differences between the numbers of flies on control fruits and treated fruits was diverse for different types of treated fruits (Table 1).

Table 1: The number of flies on different fruits treated with different concentration of formalin (Treatment) or distilled water (Control). P value was calculated with t-test. For P value, all treatments were relative to control. Here, $^{**}P<0.01$, $^{*}P<0.05$, $^{NS}P\geq0.05$.

Fruits		Control	2000 ppm	1000 ppm	750 ppm	500 ppm	250 ppm	120 ppm
Apple	Mean	5.0	0.7	1.3	1.3	1.0	2.0	3.0
	Std. Error	1.2	0.3	0.3	0.3	0.6	0.6	0.6
	P value (to control)		*	*	*	*	NS	NS
Papaya	Mean	4.3	0.0	0.3	1.3	1.3	2.7	3.3
	Std. Error	0.9	0.0	0.3	0.3	0.3	0.3	0.3
	P value (to control)		-	*	*	*	NS	NS
Mango	Mean	7.0	0.7	0.3	1.0	1.3	3.7	4.3
	Std. Error	0.6	0.3	0.3	0.6	0.3	0.7	0.9
	P value (to control)		**	**	**	**	*	NS
Orange	Mean	12.7	0.3	1.0	2.3	2.0	5.3	8.3
	Std. Error	2.3	0.3	0.6	0.9	0.6	1.5	2.0
	P value (to control)		**	**	*	*	NS	NS
Banana	Mean	4.7	0.3	1.0	1.7	2.0	2.3	3.7
	Std. Error	0.7	0.3	0.6	0.7	0.6	0.9	0.3
	P value (to control)		**	*	*	*	NS	NS

The result of the experiments with fishes was more or less similar to the result of experiments with fruits. The highest number of flies was observed on fish treated the lowest concentration of formalin while the lowest number of flies was recorded on fish treated with the highest concentration (Fig. 2 and Table 2). The number of flies on fishes treated with 250 ppm formalin was lower than the number of flies on control fishes, but the differences was statistically insignificant (Fig 2). However, this difference was statistically significant for fishes treated with ≥500 ppm formalin (Fig. 2). But, data analysis for individual fish type showed that the lowest concentration of formalin which exhibited statistically significant differences between numbers of flies varied with different fish types (Table 2).

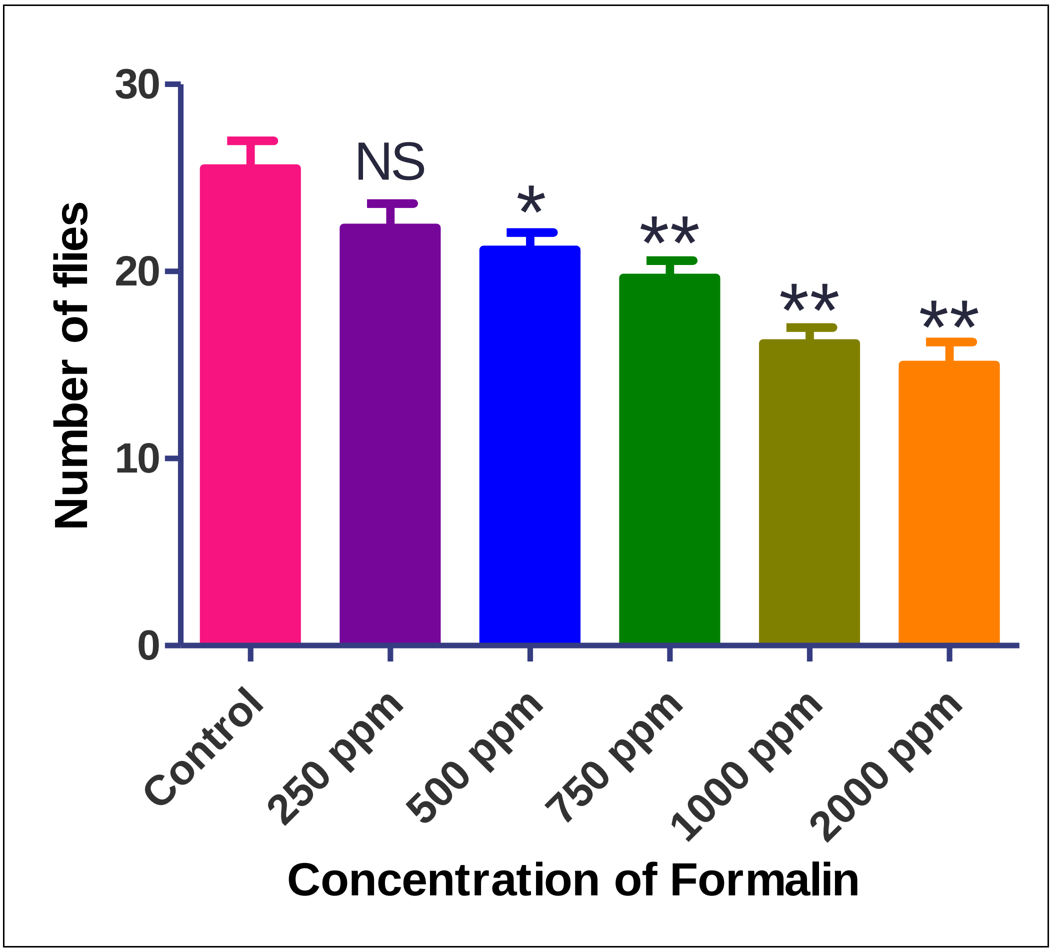

Fig 2: Effect of formalin on number of flies on fishes (Number ± SE). P value was calculated with t-test. For P value, all treatments were relative to control. Here, $^{**}P<0.01$, $^{*}P<0.05$, $^{NS}P\geq0.05$.

Table 2: The number of flies on different fishes treated with different concentration of formalin (Treatment) or distilled water (Control). P value was calculated with t-test. For P value, all treatments were relative to control. Here, $^{**}P<0.01$, $^{*}P<0.05$, $^{NS}P\geq0.05$.

Fishes		Control	2000 ppm	1000 ppm	750 ppm	500 ppm	250 ppm
Puntius titus (Hamilton, 1822)	Mean	27.7	15.0	16.7	21.0	22.3	24.7
	Std. Error	1.5	2.5	1.7	1.0	1.2	0.9
	P value (to control)		*	**	*	*	NS
Oreochromis niloticus	Mean	23.3	15.0	15.7	18.3	20.0	20.0
	Std. Error	2.0	1.2	0.7	1.2	1.2	1.5
	P value (to control)		*	*	NS	NS	NS

Discussion

Formaldehyde and acetaldehyde, which are low molecular weight aldehydes contained in foods, have received a special attention due to their high toxicity and carcinogenicity [12]. Formaldehyde is used as a preservative, reducing agent, and a sterilizing agent in food industry [13]. In this study it was found that number of flies in all samples of fruits and fishes was decreased gradually with the increase of concentration of formalin indicating that flies can detect the presence of formalin in fruits and fishes even in the lowest concentration (250 ppm). Formaldehyde is colorless and highly volatile chemical with a strong and irritating odor. Hence, flies may avoid the formalin contaminated fruits and fish as found in this study. However, percentage of avoidance of formalin contaminated fruits and fishes by flies at low concentration were not statistically significant as compared with the control. It indicates that flies are habituated to the presence of low concentration of formaldehyde in fruits and fishes. This behavior of flies may be resulted from natural presence of formaldehyde as a product of normal metabolism in many foods including fruits, vegetables, meats, fish, crustacean, and dried mushrooms [13]. Hence, flies can ignore the low concentration of formalin in fruits and fishes. However, the initial concentration of formalin which was significantly avoided by flies was different for different types of fruits and fishes. It has been reported that the level of formaldehyde is different among the species and between frozen and fresh seafood due to their different amount of trimethylamine oxide from species to species and depending on bacterial activity [13, 14]. It may be a reason of different initial concentration of formalin for significant avoidance of formalin contaminated foods by flies as found in this study.

Conclusion

It can be concluded from the findings of this study that the flies usually avoided the formalin contaminated fruits and fishes and this avoidance rate was dependent on the concentration of formalin used for contamination of studied fruits and fishes as well as on the types of fruits and fishes. Moreover, gradual enhancement of this rate of avoidance was found with the increase of the concentration of contaminating formalin. This rate of avoidance by flies for formalin contaminated fruits and fishes were significantly different from that for control fruits and fishes indicating that observation on avoidance of fruits and fishes by flies might be a way of detection of formalin contamination in fruits and fishes.

References

1. Luttrell WE. Toxic tips: formaldehyde. Chemical Health and Safety. 2003; 10(3):29-30.
2. Ashfaq S. Formalin in fruits can be fatal in Bangladesh. Dhaka, Tribune. 2013, 18-24.
3. Biemer JJ. Antimicrobial susceptibility testing by the Kirby-Bauer disc diffusion method. Annals of Clinical & Laboratory Science. 1973; 3(2):135-140.
4. Boreiko CJ, Couch DB, Swenberg JA. Mutagenic and carcinogenic effects of formaldehyde, in Genotoxic Effects of Airborne Agents. Springer. 1982, 353-367.
5. Teerasong S *et al*., A multiple processing hybrid flow system for analysis of formaldehyde contamination in food. Analytical Sciences. 2010; 26(5):629-633.
6. Bernstein RS *et al*., Inhalation exposure to formaldehyde: an overview of its toxicology, epidemiology, monitoring, and control. American Industrial Hygiene Association Journal. 1984; 45(11):778-785.
7. Cui X. *et al*., Kinetic spectrophotometric method for rapid determination of trace formaldehyde in foods. Analytica chimica acta. 2007; 590(2):253-259.
8. Mason D. *et al*., Determination of naturally-occurring formaldehyde in raw and cooked Shiitake mushrooms by spectrophotometry and liquid chromatography-mass spectrometry. Food additives and contaminants. 2004; 21(11):1071-1082.
9. Ngamchana S, Surareungchai W. Sub-millimolar determination of formalin by pulsed amperometric detection. Analytica chimica acta. 2004; 510(2):195-201.
10. Zhang S *et al*., Spoiling and formaldehyde-containing detections in octopus with an E-nose. Food Chemistry. 2009; 113(4):1346-1350.
11. Minnich DE. The chemical sensitivity of the tarsi of certain muscid flies. The Biological Bulletin. 1926; 51(3):166-178.
12. Jeong HS *et al*., Validation and determination of the contents of acetaldehyde and formaldehyde in foods. Toxicological research. 2015; 31(3):273.
13. Norliana S *et al*., The health risk of formaldehyde to human beings. American journal of pharmacology and toxicology. 2009; 4:98-106.
14. Bianchi F *et al*., Fish and food safety: Determination of formaldehyde in 12 fish species by SPME extraction and GC–MS analysis. Food Chemistry. 2007; 100(3):1049-1053.