

Detection of formaldehyde contaminated in squid from fresh markets in Muang District Nakhon Ratchasima Province, Thailand

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Abstract

The purpose of this research was to detect formalin in squid sold at a large seafood wholesale and retail market in Muang district, Nakhon Ratchasima province, Thailand. Samples of squid were randomly selected from 17 squid shops in 6 markets, with each shop contributing 100 grams of squid, and the survey was conducted four times, resulting in a total of 68 samples. An innovative paper-based sensor for formalin testing in foods from Burapha University was employed to analyze these samples. The results unequivocally revealed that fresh squid sold in all six seafood markets exhibited no traces of formalin. This signifies that all six markets in Muang district, Nakhon Ratchasima, Thailand, are not engaging in the smuggling of formalin to maintain freshness and prevent squid spoilage. Consequently, based on this study, it can be confidently concluded that there is no formaldehyde contamination in squid purchased from seafood markets in Muang district. Thus, consuming fresh squid from these markets is deemed safe and free from the risk of formalin poisoning.

Key words : detection of contamination; formalin in fresh squid

1.Introduction

The problem of food poisoning in one of the major concerns in Thai society. In 2020, the department of Health conducted a study on food poisoning by randomly inspecting, 21,080 food samples from food establishments across the country on the 30th of September 2022. It was found that 97% did not have food contamination while the other 3% did. Most toxins which were found in the food that was contaminated was from formalin, 31% to be exact. That was followed by insecticides 25%, polar compounds from cooking oil 19%, red meat accelerators 11%, mold preservatives 10%, and borax 4% respectively. Formalin is a hazardous substance and is strictly prohibited in all food products. Unfortunately, it is still being misused because of the mistaken belief that it can prolong the freshness and shelf life of food items. The rise of online marketplaces has made it easier for the public to access information about such hazardous substances and procure them, exacerbating the risk to consumers. Perishable foods, like fresh seafood including shrimp, crab, fish, and squid, particularly crispy squid from remote coastal provinces, often require measures to prevent spoilage during transportation, with chemicals being one of the methods employed. In 2020, a report from Nakhon Ratchasima College revealed that formalin was still being added to seafood by sellers in the markets of Nakhon Ratchasima province, especially in the case of squid soaking (Nakhon Ratchasima College, 2020). Additionally, a report from the Public Health Authority of Nakhon Ratchasima province, Thailand, in 2022, indicated that formaldehyde contamination was found in many seafood items, with squid being a prominent example (PBS, 2022). Squid, a popular seafood ingredient, is widely used in various dishes, including made-to-order dishes, shabu hot pots, and grilled menus. Muang district in Nakhon Ratchasima province, Thailand, is a large district administratively divided into 23 sub-districts, with a population of 467,904 people and 246,169 households, according to (The Development Plan of Nakhon Ratchasima Province for the years 2023-2027). Therefore, any

contamination of formaldehyde in squid, a staple in a multitude of dishes, can have far-reaching consequences, affecting a significant number of people.

2. Objective of the study

To investigate the presence of formaldehyde contamination in fresh squid sold to consumers in Muang district, Nakhon Ratchasima province, Thailand.

3. Research methods

3.1 Samples

3.1.1 The samples in this research consisted of fresh squid sourced from large wholesale and retail markets in Muang district, Nakhon Ratchasima province, Thailand, encompassing 6 markets with a total of 17 shops.

3.1.2 The samples used in this research were obtained through Simple Random Sampling. This method involved defining the sample group and randomly selecting fresh squid, with one sample collected from each shop, spaced 7 days apart. This process was repeated four times during the same period, resulting in a total of 68 samples. Each sample comprised fresh squid, with a minimum weight of 100 grams, collected from the 17 shops.

3.2. Research procedures

3.2.1 To review information from documents, academic textbooks, concepts, articles, and relevant research related to the detection of formaldehyde contamination in food.

3.2.2 The scope and guidelines for conducting random sampling were established in alignment with the research's objectives and challenges. The study was executed using a comprehensive experimental design.

3.3 Research tools

3.3.1 Paper-based formalin sensor test kit for testing formalin in food (An innovative paper-based sensor for formalin test in foods) developed by Burapha University, operates by comparing the color change in the paper device's diameter to determine the test result. To conduct the test, 100 grams of squid samples were soaked in 100 milliliters of distilled water for approximately 30 seconds. The testing procedure followed the instructions outlined in the test kit's manual, as follows:

1) Add 1/3 of the food soaking water to the sample reagent bottle.

2) Close the bottle cap completely. and shake for about 1 minute.

3) Place the paper measuring device horizontally. Apply 3 drops of the control reagent to the "C" compartment of the paper apparatus and 3 drops of the solution from the reagent bottle onto the "T" compartment of the paper apparatus.

4) Wait about 5 minutes and read the test results. Here's how to read the results:

4.1) Paper form "T" channel does not change color, read negative result (no formaldehyde contamination). (Fig.1a)

4.2) Paper form "T" has been changed to a small faint pink circle, read positive result. (Contaminated with formaldehyde less than 100 ppm) It is within the safe limit. (Fig.1b)

4.3) Paper form "T" channel has been changed to a large dark pink circle. read positive result (Contaminated with formaldehyde more than 100 ppm.) It is in the unsafe criteria. (Fig.2a)

4.4) Paper form "C" channel does not change color, while paper form "T" channel may change color or not. Indicates that the test kit is unavailable. (Fig.2b)

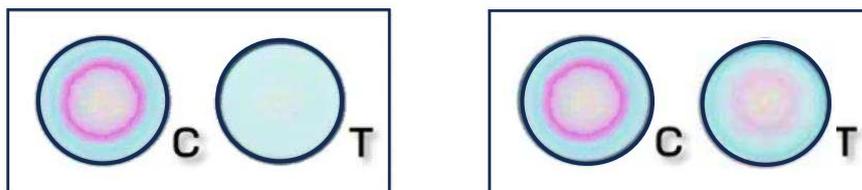


Fig.1 (a) no formaldehyde contamination; (b) Contaminated with formaldehyde less than 100 ppm.

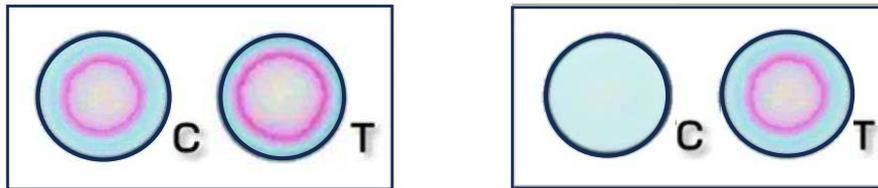


Fig.2 (a) Contaminated with formaldehyde more than 100 ppm.; (b) the test kit is unavailable.

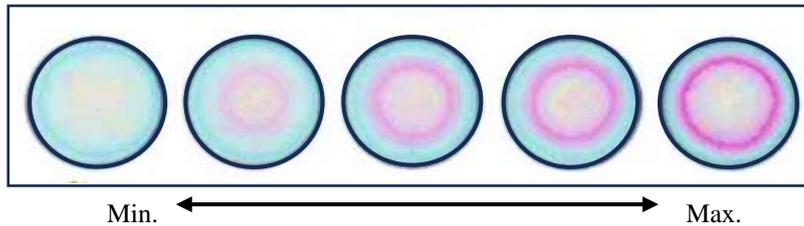


Fig.3 contaminated formalin concentration

3.3.2 Examination Results Record Form Formalin contamination in squid samples.

3.4 Data Collection Procedure

3.4.1 The research team surveyed the wholesale and retail markets in Muang district, Nakhon Ratchasima province, Thailand, where fresh squid is sold.

3.4.2 The research team formulated a plan to determine the date and time of their visits to the sampling area, during which purchased 100 grams of squid from each shop.

3.4.3 The collected squid samples were placed in labeled bags, indicating the source, date, and time, and assigned a sample code. The bag's opening was sealed, and they were then stored in foam boxes with ice to maintain their freshness.

3.4.4 The samples were tested in the Suranari School laboratory, following the sequence of the assigned sample codes, and the results were documented on the forms.

3.5 Data analysis

Data analysis was divided into quantitative data analysis and qualitative data analysis.

Quantitative data were analyzed by screening results for formalin contamination were shown as percentages. Qualitative data were analyzed by describing, comparing data, and evaluating the situation of formaldehyde contamination in squid.

4. Results

The samples sampling for 4 times, duration could be controlled accounting 100%. For instance, Market A, which comprises 7 shops, conducted sample collection between 09:00-09:30 a.m., Market B, with 3 shops, conducted sampling from 10:00-10:30 a.m., Market C has 2 shops, performed sample collection from 11:00-11:30 a.m., Markets D and E, the afternoon markets conducted sampling between 15:00-15:30 p.m. and Market F, a morning market with 2 shops, conducted sampling from 06:00-06:30 a.m., as illustrated in Table 1.

The assessment of formaldehyde contamination in fresh squid from fresh markets in Muang district Nakhon Ratchasima province, Thailand, involved six markets, totaling 17 shops, and yielded a total of 68 samples. Notably, none of the samples tested positive for formaldehyde contamination. These results demonstrate the absence of formaldehyde contamination in fresh squid available in Muang district, Nakhon Ratchasima province, Thailand, as shown in Table 2.

Table 1. Sampling duration

shop No.	market	shop	Sampling duration (date/time)			
			No.1 (4 Aug 2023)	No.2 (11 Aug 2023)	No.3 (18 Aug 2023)	No.4 (25 Aug 2023)
1	A	A1	09:00 a.m.	09:00 a.m.	09:05 a.m.	09:00 a.m.
2	A	A2	09:03 a.m.	09:04 a.m.	09:08 a.m.	09:05 a.m.
3	A	A3	09:07 a.m.	09:07 a.m.	09:15 a.m.	09:09 a.m.
4	A	A4	09:11 a.m.	09:10 a.m.	09:20 a.m.	09:13 a.m.
5	A	A5	09:15 a.m.	09:15 a.m.	09:25 a.m.	09:17 a.m.
6	A	A6	09:19 a.m.	09:20 a.m.	09:28 a.m.	09:22 a.m.
7	A	A7	09:22 a.m.	09:23 a.m.	09:30 a.m.	09:27 a.m.
8	A	A8	09:25 a.m.	09:30 a.m.	09:35 a.m.	09:30 a.m.
9	B	B1	10:00 a.m.	10:05 a.m.	10:15 a.m.	10:05 a.m.
10	B	B2	10:03 a.m.	10:10 a.m.	10:21 a.m.	10:10 a.m.
11	B	B3	10:07 a.m.	10:15 a.m.	10:30 a.m.	10:15 a.m.
12	C	C1	11:00 a.m.	11:20 a.m.	11:25 a.m.	11:10 a.m.
13	C	C2	11:10 a.m.	11:25 a.m.	11:30 a.m.	11:15 a.m.
14	D	D1	03:00 p.m.	03:00 p.m.	03:00 p.m.	03:00 p.m.
15	E	E1	03:15 p.m.	03:15 p.m.	03:15 p.m.	03:15 p.m.
16	F	F1	06:13 a.m.	06:00 a.m.	06:10 a.m.	06:00 a.m.
17	F	F2	06:20 a.m.	06:05 a.m.	06:15 a.m.	06:06 a.m.

Sampling duration: market A 09:00-09:30 a.m., market B 10:00-10:30 a.m., market C 11:00-11:30 a.m.
 market D and E 03:00-03:30 p.m., market F 06:00-06:30 a.m.

Table 2. Determination results of formalin in fresh squid.

shop No.	market	shop	results of formaldehyde detection (-,+)				negative %	positive %
			No.1	No.2	No.3	No.4		
1	A	A1	-	-	-	-	100 %	0 %
2	A	A2	-	-	-	-	100 %	0 %
3	A	A3	-	-	-	-	100 %	0 %
4	A	A4	-	-	-	-	100 %	0 %
5	A	A5	-	-	-	-	100 %	0 %
6	A	A6	-	-	-	-	100 %	0 %
7	A	A7	-	-	-	-	100 %	0 %
8	A	A8	-	-	-	-	100 %	0 %
9	B	B1	-	-	-	-	100 %	0 %
10	B	B2	-	-	-	-	100 %	0 %
11	B	B3	-	-	-	-	100 %	0 %
12	C	C1	-	-	-	-	100 %	0 %
13	C	C2	-	-	-	-	100 %	0 %
14	D	D1	-	-	-	-	100 %	0 %
15	E	E1	-	-	-	-	100 %	0 %
16	F	F1	-	-	-	-	100 %	0 %
17	F	F2	-	-	-	-	100 %	0 %

5. Discussion

Formalin is a hazardous chemical. If it contaminates food and is ingested, it can adversely affect health in various ways. Those who are sensitive to this substance may face fatal consequences. Therefore, implementing screening for chemical contamination in food and raising awareness is an essential educational measure to prevent the consumption of foods susceptible to formaldehyde contamination. Moreover, it serves as a deterrent against smuggling and misuse. Formaldehyde contamination in food can have widespread consequences in densely populated urban areas, such as Muang district in Nakhon Ratchasima province, Thailand. Therefore, our research team has focused on studying food safety, with a particular emphasis on squid, a popular seafood used in various dishes. According to a report from Nakhon Ratchasima College in 2020, positive formalin contamination was found in various seafood items, including squid, crispy squid, big fin reef squid, fish, and immature squid soaking. Out of 35 samples, 6 (17.14%) showed signs of seafood soaking in formalin.

Fresh squid samples were collected from a large, fresh seafood market in Muang district, Nakhon Ratchasima province, Thailand, which included 6 markets and 17 shops. These samples were collected once a week over a period of 4 weeks in August 2023, all during the same duration. They were then screened using an innovative paper-based sensor for formalin testing developed by Burapha University. The results were conclusive: all 68 samples (100%) tested negative, indicating no formaldehyde contamination. This suggests that the squids sold in fresh seafood shops within the large markets of Muang district, Nakhon Ratchasima province, Thailand, either have no formaldehyde contamination or have such a minimal amount that it falls below the detection threshold of the testing kit. This reflects a positive trend in consumer protection measures within Muang district, Nakhon Ratchasima province, Thailand.

6. Conclusion

The findings from Nakhon Ratchasima College's 2020 report highlighted alarming instances of formalin contamination in various seafood samples, emphasizing the pressing need for vigilance in this matter. However, the recent screening initiative conducted in August 2023, involving 68 fresh squid samples collected from prominent fresh seafood markets in Muang district, Nakhon Ratchasima province, Thailand, revealed a reassuring outcome. All samples tested negative for formaldehyde (100%), indicating the absence of formaldehyde contamination and a commitment to safety standards among the fresh squid vendors in the area. This positive trend in consumer protection measures is a testament to the collective efforts in Muang district, Nakhon Ratchasima province, Thailand, to ensure the safety and well-being of its residents.

7. Recommendation

For further research, the survey area should be expanded to include community-based retail shops, food made-to-order shops, and restaurants that purchase fresh squid from the large market to prepare and cook for consumers. Additionally, consumers should be educated on observation methods for selecting fresh squid that may be at risk of formalin contamination, ensuring safe consumption.

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References

- Adun Bunchaleamchai, Kawisara Kunpee, Tanatcha Damyang, Natnapa Tunkaya, Waree Taweepanyasat, Sawanya Pongparit and Boontarika Thongdonphum. (2019). A Case Study of the Determination of Formalin Contaminated in Fresh Seafood from Fresh Market with Far from Coastal Area Provinces. *Burapha Science Journal*, 24 (3) September – December 2019, 1111-1119.
- Associate Professor Dr. Yupaporn Sameenoi, Faculty of Science Burapha University (December 14, 2022). Burapha University released portable formalin test kit. Capital Administration and Management Unit for National Competitiveness Enhancement (KDA). <https://cemb.sc.mahidol.ac.th/assets/files/technomart/OMDT-05.pdf>
- Boonnak Sakan. (December 8, 2022). Thailand systematized formaldehyde in danger substance. Ministry of Public Health. <https://pr.moph.go.th/print.php?url=pr/print/2/02/182641/>
- Center for Information and Investigative News for Civil Rights. (December 6, 2022). Scholars advised how to noticed formaldehyde contaminating food. from <https://www.tcijthai.com/news/2022/12/current/12695>
- Chiang Mai University. (July 1, 2015). Sampling for reserch. <https://plan.eng.cmu.ac.th/wp-content/uploads/2015/07/sampling.pdf>
- Chiang Mai University. (June 9, 2018). feasibility of investment on plasma machine in order to wash seafood for commercial purpose. https://archive.lib.cmu.ac.th/full/T/2561/inma90661trpky_ch1.pdf
- Consumer Protection and Pharmacy Public Health Group Nakhon Ratchasima Provincial. (December 14, 2022). Founded 6 type of formaldehyde contaminating food. PPTV Online. <https://www.pptvhd36.com/news//186525>
- Department of Medical Services, Ministry of Public Health. (December 8, 2022). Wrong usage of formaldehyde leads to Cancer. Ministry of Public Health. <https://pr.moph.go.th/?url=pr/detail/2/02/182641/>
- Faipet Thinakorn. (2017). Detection of Formalin in Seafood from the Market in U Thong District, SuphanBuri Province, Thailand. *Journal of Council of Community Public Health*2020; 2(2), 26-36.
- Girousi, S., Golia, E., Voulgaropoulos, A. *et al.* Fluorometric determination of formaldehyde. *Fresenius J Anal Chem* **358**, 667–668 (1997). <https://doi.org/10.1007/s002160050488>
- Kansuthi Rattapong (2010). Analyzing the amount of formaldehyde in seafood from market in Chiang Mai. Digital Research Information Center "NRCT." (Chiang Mai University). https://doi.nrct.go.th/ListDoi/listDetail?Resolve_Doi= 10.14457/CMU.the.2010.423
- Kasetsart University. (n.d.). Case study of squid resources in Pran Buri district and Sam Roi Yot district Prachuap Khiri Khan province. <https://research.ku.ac.th/forest2/project/20145720021001>
- Nussaba Namwong, Sawangpong Ruangsri, Khemjira Kanyala, Noorhuda Suwannurak, Laddawan Phaworn, Malinee Thani, Parichat Ong-art and On-uma Chansathien Wipawan Buasriyod. (2020). Detection of Formalin in Seafood's Soaking at a Market in Nakhon Ratchasima Province. The seventh National Academic Conference Nakhon Ratchasima College in 2563 "Innovation for health and social in digital period", 1016-1023.
- Pumpath Putpadungwipon1, Sunisa Chumcheun, Titima Tonon, WiriyaPhuprasitpol, PornnapatPanthana, Natchayakorn Netwong, and Orn-Uma Yanpanitch. (2016). Detection of Formalin Contamination in Fresh Squids and Shrimps in Muang-Ake Community, Patumtanee Province. RSU National Research Conference 2016, 41-48.
- Songkhla Aquatic Animal Product Quality Research and Inspection Center, Fishery Product Quality Inspection Division, Department of Fisheries. (April 15, 2020). The examine formaldehyde in food method. <https://www4.fisheries.go.th/doffile /fkey/ref53415>