An investigation of formaldehyde in seafood from fresh markets in Bangkok, Chiangmai, Chumphon, Khon Kaen and Saraburi

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Abstract

Background: formaldehyde contaminants have been detected in seafood all the time in different areas formaldehyde is a dangerous chemical. If food is contaminated, it can be detrimental to health and various systems in the body.

Objective: To detect formaldehyde contaminants in seafood in Bangkok, Chiang Mai, Chumphon, Khon Kaen and Saraburi regions.

Methods: We select a random sampling method to buy 202 samples of seafood from different locations. formaldehyde detection was examined by formaldehyde test kits, manufactured by the department of medical science.

Result: From the study of formaldehyde detection in water soaked in 202 seafood samples in Bangkok, Chiang Mai, Chumphon, Khon Kaen and Saraburi provinces. formaldehyde was found to be contaminated in the soaking water of 17 seafood samples, or 8.4%.

Formaldehyde was found to be contaminated. From the 11 crispy squid samples, 64.7% of all samples were contaminated with formaldehyde. 4 samples of fresh squid, equivalent to 14.7 %, fresh shrimp, 1 sample, or 5.8%, and striped shellfish, 1 sample, or 5.8%.

When analyzing by area, it was found that from the seafood infusion samples randomly taken from Saraburi Province, 5 of 30 samples of formaldehyde, representing 16.7%, were found in Bangkok, 9 of 85 samples, or 10.6%, and Chiang Mai, 2 of 30, or 6.7% and Chumphon Province, one sample out of 23 samples, or 4.3%. No formaldehyde was detected.

Conclusion: Formaldehyde has also been found to be contaminated in seafood in many areas.

Keywords: formaldehyde; seafood; food safety

Background

Department of fisheries, Thailand (2022)[1] 151st decree issued in 1993 by the Ministry of Public health mandates that "formaldehyde is prohibited as a food preservative" for the following reasons: formaldehyde is a chemical substance that consists of a mixture of aqueous methanal (Formaldehyde) and methanol (methyl alcohol). Bangon Changsap (2013)[2] Food Network Solution[3] Consumer Thai[4] formaldehyde is considered a intensely toxic substance to human. Skin contact with the substance can cause irritation or even allergic reactions in some people. Furthermore, formaldehyde can cause red eyes, excessive tears, or eye irritation. In case of inhale, it can irritate the nasal cavity and the respiratory pathway which can cause dryness, loss of smell, lung inflammation and respiratory failure in the worst case. When ingested in large amount, it can cause severe vomiting. Kidneys can also be affected on related diseases such as jaundice, albuminuria, blood in urine, difficulty urinating, low blood PH. It can also cause seizures and inhibit the central nervous system from functioning properly which leads to loss of consciousness and death from heart failure eventually. The body metabolises formaldehyde into formic acid (Methanoic acid) which can irritate body tissues. formaldehyde is also a carcinogenic substance as it can bind to and damage to DNA, Leukaemia and respiratory tract. This can lead to cancer likewise.

Tests for formaldehyde contamination in foods are being carried out all the time. A study carried out in in Nakhon Ratchasima by Wilawan Buasriyod and et al. (2022) [5] found traces of formaldehyde in 6 seafood samples out of 35 from a fresh market in the province. The rate of contamination is 17.14%. A study for formaldehyde in seafood carried out in Suphan Buri, U-Thong district, by Thinakorn Faipet (2020)[6]. Samples were bought from fresh markets and tested. 5 were contaminated out of 48 samples. A report from the Fisheries Industrial Technology Research and Development Division in 2019[7] stated that trace of formaldehyde could be found in marine animal samples. A study investigated the amount of formaldehyde by Adun Bunchaleamchai (2019)[8] in fresh markets which are far from coastal areas found formaldehyde in 11 seafood samples out of 91, making the contamination rate at 12.09%. From the studies mentioned above, we can see that formaldehyde is still being applied as a food preservative even though the practice has been prohibited.

This research aims to study Detection of formaldehyde in seafood sold in the fresh markets in Bangkok area Chiang Mai, Chumphon, Khon Kaen and Saraburi for information on contamination surveillance.

Objective of the study

To inspect the trace of formaldehyde in seafood from markets in Bangkok, Chiang Mai, Chumphon, Khon Kaen and Saraburi

Instruments and Tools

Sampling

The samples were randomly selected (Random Sampling Methods) from fresh markets in 5 different provinces of Thailand. The provinces are in Bangkok, Saraburi - Mueang District, Chiang Mai - Mueang District, Chumphon - Mueang District, and Khon Kaen – Chum Phae District. A total of 210 samples from 49 different shops were collected and left to soak in water. The water was then collected in sterile plastic bags. The bags were labelled then packaged into a foam container with ice on top and bottom. The samples were tested suddenly.

Tools

The test for aqueous formaldehyde was examined by using test kits provided by the Ministry of Public Health and plastic cups were used as the testing containers.[9]

Test procedure

The test kit contains 3 bottles of chemicals labelled 1, 2, and 3.
1) The water samples were poured into bottle 1 until it was filled ⅓ way, the bottle was then capped and shaken until all solids were dissolved.
2) Contents from bottle 1 were poured into bottle 2. The bottle was capped and shaken until all solids were dissolved.
3) Contents from bottle 2 were mixed with the liquid in bottle 3 then shaken. Results displayed by mixing the 2 bottles show whether or not the sample has been contaminated with formaldehyde

Result Interpretation

The mixing of contents in bottles 2 and 3 shows whether or not the sample was contaminated with formaldehyde. After mixing, if the liquid changes colour to red/pink, is it a positive result (+), meaning the sample is contaminated. If no colour change takes place, then the test is negative (-), meaning the sample has not been contaminated. (Figure 1.)

Figure 1. The picture showed colour metric to interpret result of formaldehyde detection

Result

From the determination of formaldehyde residues in 202 seafood samples, 11 of 26 samples of formaldehyde was found in the water soaked in crispy squid, of which 5 samples out of 5 were randomly purchased from Saraburi province. Samples, representing 100% of the samples randomly purchased from Chiang Mai, 2 out of 5 samples, representing 40 %, and 4 of 14 samples randomly purchased from Bangkok, representing 28.6%, in squid-soaked water. 4 of the 37 samples, representing 10.8%, were purchased at random from Bangkok, 4 of 15 samples, representing 26.7%, in one sample of 33 samples, representing 3% of the samples. The samples were randomly purchased from Bangkok, 1 sample out of 15, accounting for 6.7 %, and in the water-soaked clams 1 sample out of 22 samples, which was 1 sample out of 5 in Chumphon province, accounting for 20% of the samples. Others consisted of blue crab, cuttlefish, mackerel, mussels and snapper. No formaldehyde was found.

Table 1. Detection of formaldehyde in seafood soaking water by formaldehyde test kit by types of sample (N=202)

Type	Location	No. of sample	Result		
			Positive	Negative	% Detect formaldehyde
Blue crab	Total	10	0	10	0.0%
	Bangkok	5	0	5	0.0%
	Chiangmai	1	0	1	0.0%
	Chumphon	2	0	2	0.0%
	Khon Kaen	1	0	1	0.0%
	Saraburi	1	0	1	0.0%
Clam	Total	22	1	21	4.5%
	Bangkok	7	0	7	0.0%
	Chiangmai	4	0	4	0.0%
	Chumphon	5	1	4	20.0%
	Khon Kaen	2	0	2	0.0%
	Saraburi	4	0	4	0.0%
Cuttlefish	Total	5	0	5	0.0%
	Bangkok	0	0	0	0.0%

	Chiangmai	0	0	0	0.0%
	Chumphon	0	0	0	0.0%
	Khon Kaen	5	0	5	0.0%
	Saraburi	0	0	0	0.0%
Mackerel	Total	35	0	35	0.0%
	Bangkok	15	0	15	0.0%
	Chiangmai	5	0	5	0.0%
	Chumphon	5	0	5	0.0%
	Khon Kaen	5	0	5	0.0%
	Saraburi	5	0	5	0.0%
Mussel	Total	33	0	33	0.0%
	Bangkok	14	0	14	0.0%
	Chiangmai	5	0	5	0.0%
	Chumphon	6	0	6	0.0%
	Khon Kaen	3	0	3	0.0%
	Saraburi	5	0	5	0.0%
Crispy Squid	0	26	11	15	42.3%
	Bangkok	14	4	10	28.6%
	Chiangmai	5	2	3	40.0%
	Chumphon	0	0	0	0.0%
	Khon Kaen	2	0	2	0.0%
	Saraburi	5	5	0	100.0%
Sea Bass	Total	1	0	1	0.0%
	Bangkok	0	0	0	0.0%
	Chiangmai	0	0	0	0.0%
	Chumphon	0	0	0	0.0%
	Khon Kaen	1	0	1	0.0%
	Saraburi	0	0	0	0.0%
Shrimp	Total	33	1	32	3.0%
	Bangkok	15	1	14	6.7%
	Chiangmai	5	0	5	0.0%
	Chumphon	3	0	3	0.0%
	Khon Kaen	5	0	5	0.0%
	Saraburi	5	0	5	0.0%
Squid	Total	37	4	33	10.8%

	Bangkok	15	4	11	26.7%
	Chiangmai	5	0	5	0.0%
	Chumphon	2	0	2	0.0%
	Khon Kaen	10	0	10	0.0%
	Saraburi	5	0	5	0.0%
Total		202	17	185	8.4%

202 samples of formaldehyde residues in seafood were tested, divided into provinces that randomly purchased fresh seafood samples for testing. formaldehyde was found in the soaking water of fresh seafood samples randomly purchased from Saraburi province of 5 out of 30 samples, representing 16.7%. formaldehyde was found in the soaking water of seafood samples randomly purchased from the district. Bangkok 9 samples out of 85 samples, representing 10.6%, found formaldehyde in the soaking water, 2 of the 30 samples of seafood randomly purchased from Saraburi Province, or 6.7 %, were found for formaldehyde. 1 sample of 23 seafood samples randomly purchased from Chumphon province, representing 4.3 %, and from seafood randomly purchased in Khon Kaen province, no formaldehyde was detected in Khon Kaen province in soaking water samples.

Table 2**.** Detection of formaldehyde in seafood soaking water by formaldehyde test kit by location (N=202)

Location	Type	No. of sample	Result		
			Positive	Negative	% of sample detected formaldehyde
Bangkok	Total	85	9	76	10.6%
	Blue crab	5	0	5	0.0%
	Clam	7	0	7	0.0%
	Cuttlefish	0	0	0	0.0%
	Mackerel	15	0	15	0.0%
	Mussel	14	0	14	0.0%
	Crispy squid	14	4	10	28.6%
	Sea Bass	0	0	0	0.0%
	Shrimp	15	1	14	6.7%
	Squid	15	4	11	26.7%
Chiangmai	Total	30	2	28	6.7%
	Blue crab	1	0	1	0.0%
	Clam	4	0	4	0.0%
	Mackerel	5	0	5	0.0%
	Mussel	5	0	5	0.0%
	Crispy squid	5	2	3	40.0%
	Shrimp	5	0	5	0.0%
	Squid	5	0	5	0.0%
Chumphon	Total	23	1	22	4.3%

	Blue crab	2	0	2	0.0%
	Clam	5	1	4	20.0%
	Cuttlefish	0	0	0	0.0%
	Mackerel	5	0	5	0.0%
	Mussel	6	0	6	0.0%
	Crispy Squid	0	0	0	0.0%
	Sea Bass	0	0	0	0.0%
	Shrimp	3	0	3	0.0%
	Squid	2	0	2	0.0%
Khon Kaen	Total	34	0	34	0.0%
	Blue crab	1	0	1	0.0%
	Clam	2	0	2	0.0%
	Cuttlefish	5	0	5	0.0%
	Mackerel	5	0	5	0.0%
	Mussel	3	0	3	0.0%
	Crispy squid	2	0	2	0.0%
	Sea Bass	1	0	1	0.0%
	Shrimp	5	0	5	0.0%
	Squid	10	0	10	0.0%
Saraburi	Total	30	5	25	16.7%
	Blue crab	1	0	1	0.0%
	Clam	4	0	4	0.0%
	Cuttlefish	0	0	0	0.0%
	Mackerel	5	0	5	0.0%
	Mussel	5	0	5	0.0%
	Crispy squid	5	5	0	100.0%
	Sea Bass	0	0	0	0.0%
	Shrimp	5	0	5	0.0%
	Squid	5	0	5	0.0%
Total		202	17	185	8.4%

Discussion

From the results of the study on the detection of formaldehyde in water soaked in 202 seafood samples randomly purchased in Bangkok, Chiang Mai Province, Chumphon Province, Khon Kaen and Saraburi province, formaldehyde contaminants were found in the soaking water of 17 seafood samples, representing 8.4%. Due to the types of samples analysis, it was found formaldehyde in 11 crispy squid samples, accounted for 64.7% of all

formaldehyde contaminated samples. 4 samples were randomly from Bangkok, 2 in Chiang Mai and 5 in Saraburi. The next category was 4 fresh squid samples, representing 14.7% of samples that were contaminated with formaldehyde that is an example from the entire Bangkok region. The next category was a fresh shrimp samples, representing 5.8%, which was collected from the Bangkok area and 1 sample of clam soaking water, representing 5.8%, which is the sample from Chumphon province. When analyzing the area of sampling, it was found that in seafood soaking water samples at random from Saraburi province, 5 out of 30 samples of formaldehyde were found, accounting for 16.7%, followed by the samples from Bangkok. formaldehyde was detected in 9 of 85 samples, representing 10.6% of formaldehyde. Chiang Mai province 2 samples from 30 samples, representing 6.7 %, and Chumphon province 1 sample from 23 samples, accounting for 4.3%. No formaldehyde was detected. When analyzing the results of this study, formaldehyde was detected in the Bangkok area in 9 of 85 samples, representing 10.6%. Report of the monitoring results of formaldehyde contamination in fresh aquatic animals, fiscal year 2019 by the Aquaculture Industry Technology Research and Development Division[7], found the formaldehyde contamination rate in fresh aquatic animals in 2019, as 0.35% in 2018 or 0% in 2017 and 0.82% in 2017, which can be considered a continuously low level. This may be because of the study during the Coronavirus disease starting in 2019 outbreak under epidemic control measures and preventing the spread of COVID-19, many agencies, companies, shops and various schools allowed to work or study online from home. Furthermore, some people moved back to their hometown in other provinces. As a result, consumption in the Bangkok area has decreased, together with the rising cost of living. For this reason, people eat out to spend less including less seafood being sold. This may be a reason of the operator's choice to preserve the condition of fresh seafood by adding formaldehyde[10]. Based on the analysis of the detection of formaldehyde in 1 sample out of 23 samples randomized in Chumphon province. According to the large number of clam catches during 2019-2020[11], during the COVID-19 outbreak, many restaurants are temporarily closed and consumption is reduced. As a result, clams, which are in large quantities, cannot be distributed. The entrepreneurs have to keep clams for sale so formaldehyde was added to clams to maintain freshness[10] in Chiang Mai and Saraburi provinces. formaldehyde was found in only 1 type of seafood samples, which was crispy squid. For the fresh seafood, no formaldehyde was detected. The analysis was divided into 2 issues as follows: 1) Remote areas of seafood
producing provinces was no correlation with the use of formaldehyde to preserve seafood, unlike Adun Bunchaleamchai and et al. (2019)[8], which found that formaldehyde use in large quantities were found in remote coastal areas. In issue 2) formaldehyde impurities were detected in crispy ink samples from Chiang Mai, Saraburi and Bangkok areas. It was found that formaldehyde is often used in crispy squid because crispy squid is a food that requires its meat to be flexible and crunchy, producers or cooks may add formaldehyde to it without proper precaution.[12] The researcher team did not detect formaldehyde in seafood-soaked samples from Khon Kaen province.

This may be due to random testing and surveillance of various foods that are continuously sold to consumers by the relevant agencies both the Food and Drug Administration and relevant agencies in the area[13-14] if randomly detected chemical contaminants in seafood Local Food and Drug Administration.

The source of the contaminated food will be examined by asking the vendors who receive the products for sale to know whether those food sources are safe or not including make sure not to bring products from unsafe sources to distribute to consumers again. Constant surveillance is one of the key factors in food safety prior to reaching the consumers.

Limitation

This research is in Bangkok, Chumphon, Chiangmai, Khon Kaen and Saraburi. The results of this study may not represent all regions in Thailand. Using test kits from the Department of Medical Sciences (Test Kits) that can only detect positive or negative, unable to conclude the concentration of formaldehyde which is less accurate than laboratory testing.

Conclusion

From the results of the study of formaldehyde in water soaked in 202 seafood samples in Bangkok, Chiang Mai, Chumphon, Khon Kaen and Saraburi provinces. formaldehyde was found to be contaminated in the soaking water of 17 seafood samples, or 8.4%.

Formaldehyde was found to be contaminated. 11 crispy squid samples, 64.7% of all samples were contaminated with formaldehyde. 4 samples of fresh squid, equivalent to 14.7 %, fresh shrimp, 1 sample, or 5.8%, and striped shellfish, 1 sample, or 5.8%.

When analyzing by area, it was found that the seafood infusion samples randomly taken from Saraburi province, 5 of 30 samples of formaldehyde, representing 16.7%, were found in Bangkok, 9 of 85 samples, or 10.6%, and Chiang Mai, 2 of 30, or 6.7 % and Chumphon province, 1 out of 23 samples, or 4.3%. No formaldehyde was detected.

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