

FORMALIN LEVELS IN WHITE TOFU BASED ON DISTRIBUTION CHANNELS AND TIME STORAGE IN JEMBER REGENCY, 2019

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ABSTRACT

Formalin is one type of hazardous additives that are still often used by tofu traders or other food processors with the aim of improving the color and texture of food and inhibiting the activity of microorganisms so that food products can be stored longer. Storage by soaking tofu using water can reduce formaldehyde levels. The use of formaldehyde in tofu often relates to the distribution channel,^[1] of tofu from producers to consumers so the use of these chemicals in food needs to be watched out together, both by producers and consumers. This study aims to determine the presence of formalin in white tofu based on distribution channels and storage time in Jember Regency. This type of research is an experimental laboratory using a cross section approach. Tofu storage time testing of formaldehyde content is carried out by giving treatment to white tofu that has been known to be positive containing formaldehyde from a sample of producers and traders. The sample was divided into four groups, namely one control group (K) and three treatment groups (X1, X2, and X3). The results obtained did not get formaldehyde content in white tofu samples sold at the producer level, while at the merchant level obtained formalin content as much as,^[2] samples from 24 samples (8.3%). Formalin levels in white tofu at the trader level varied from 4.2 to 4.8 ppm. There is an opposite relationship between the storage time of white tofu on formalin levels (correlation coefficient of -0.941) and there is the effect of storage time on formalin levels p value = 0,000. There is a difference in formalin tofu storage time to formalin levels p value = 0,000 (p < 0.05).

KEYWORDS: Formaldehyde, tofu, distribution channel, storage period.

INTRODUCTION

Food safety is a very important aspect in daily life because people need something better for the future, a safe food, more quality and nutritious for consumption. Food that is safe, high quality and nutritious is important for its role in the growth, maintenance and improvement of the health and intelligence of the society.^[1] Lack of attention to food safety often impacts health problems, for example the incidence of food poisoning due to unhygienic processing until processing and presentation the use of hazardous chemicals that are at risk of causing degenerative diseases, cancer and even death.^[28] The use of food additives is basically permitted, if the additives used are legal and not harmful to consumers. The problem that arises is that many producers and traders do not pay attention to this matter, so they add hazardous materials such as borax, formalin, etc.^[3] The use of formalin in tofu is found on the market. RI's 2013 BPOM data on 24,906 food test results showed that there were 115 formalin samples.^[8] Formalin levels in tofu in

Padang's suburban market were also reported from 18 examined samples, there were 17 samples that were formalin positive with the highest content was 2.73 % while the formalin content in tofu in the downtown market of Padang, of the 18 samples examined, there were 17 positive samples with the highest levels of formalin was 3.65%.^[23]

Formalin is a type of dangerous additives which are still often used freely by irresponsible traders or food processors. This is because formalin is much cheaper than other preservatives, easy to use because it is in the form of a solution and low knowledge to traders about the dangers of formalin.^[29] The purpose of using hazardous chemicals such as formalin in food is usually done to improve the color and texture of food and inhibit the activity microorganisms so food products can be stored longer.^[30] One of the traders who use formalin chemicals as food chemical additives is a tofu trader.

In general, to make tofu more durable, producers and tofu traders add preservatives which also function as disinfectants. The types of disinfectants commonly used are chlorine and formaldehyde (formalin). Tofu storage in formalin water is done when tofu is ready to sell which will make tofu become harder and more resilient so that it is not easily destroyed and resistant to microorganisms, so it can last up to seven days^[29] On the other hand immersion using water is able to reduce formaldehyde levels. Formalin compounds have a CH₂O group that easily binds to water and an aldehyde group that easily binds to proteins.^[26]

The use of formalin in tofu often relates to tofu distribution channels from producers / suppliers to consumers / customers. The use of chemical additives especially formalin in food needs to be watched out together, both by producers and consumers. The use of formalin in food is not allowed because it can cause poisoning to the human body. Excessive exposure can cause death. The potential chronic health effects caused by formaldehyde are cancer and changes in cell function. Formalin is also teratogenic in humans.^[25]

Based on this explanation, the researchers were interested in examining the formaldehyde content of white tofu in a qualitative and quantitative way based on the distribution channel and duration of storage in Jember Regency. This research is expected to provide information and input as well as additional evidence of the dangers of formalin as an additive in food and beverages.

RESEARCH METHOD

This research is a quantitative research with experimental laboratory type by using cross sectional approach. Observations were made through interviews using questionnaires and laboratory tests. The tofu sample in this study is white tofu at the producer and market trader level in Kaliwates sub-district, Jember Regency, which

fulfills the sample criteria. The sampling technique used was random sampling. The total sample is 34 samples, namely 10 tofu samples at producer level and 24 tofu samples at trader level.

Qualitative testing is carried out using the formalin test kit method, if positive the quantitative test is continued by using the spectrophotometric method. The formalin test was carried out at the Pharmacology Laboratory of the Faculty of Dentistry, University of Jember and the quantitative formalin test at Jember Polytechnic Food Analysis Laboratory.

Tofu storage time testing of formaldehyde content is carried out by giving treatment to white tofu that has been known to positively contain formalin from a sample of producers and traders. The sample was divided into four groups, namely one control group (K) and three treatment groups (X1, X2, and X3). The control group (K) is formalin tofu that is not stored in water. The first treatment group (X1) is formalin tofu stored in water for 24 hours, the second treatment group (X2) is formalin tofu stored in water for 48 hours and the third treatment group (X3) is formalin tofu stored in water for 72 hours.

Formalin test results data were processed by using SPSS 16 (Statistical Package for the Social Science) with a significance level of 0.05 ($p = 0.05$) and a confidence level of 95% ($\alpha = 0.05$). Analysis of the data used is the Independent t test, Pearson Correlation, and ANOVA

RESULT AND DISCUSSION

There are two groups of respondents in this study, namely producers who supply tofu to the traditional wholesale market and tofu traders in the traditional wholesale market of Jember Regency. Each group of respondents consisted of 10 producers and 24 traders. The description of respondent data is presented in Table 1 and Table 2.

Table 1: The Overview of Tofu Producers in Jember Regency.

	Frequency	Percentage (%)
Age group		
>60 years	4	40
51-60 years	3	30
41-50 years	2	20
< 40 years	1	10
Period of Selling		
>40 years	1	10
31-40 years	3	30
21-30 years	5	50
<20 years	1	10
Education Level		
Ungraduated Primary School	1	10
Graduated Primary School	2	20
Graduated Junior High School	4	40
Graduated Senior High School	3	30

Income Average (Rp)/day		
10-100 /day	7	70
>100 /day	3	30
Impact of Giving BTM		
Yes	9	90
No	1	10
Attitudes towards the Use of Formalin in Tofu		
Supported	2	20
Not Supported	8	80

Source: Primary Data 2012

Most producers are at the age of > 60 years which is equal to 40%, most of the respondents are elderly. The most length of business is 21-30 years which is 50% and the education level of the majority of producer respondents is graduated from junior high school which is 40%. The producer income is at most 100-500

thousand at 70% and regarding the impact of providing food additives (BTM), most of them stated that they had an impact, namely around 90% of respondents. Attitudes towards the use of formaldehyde in tofu, Most manufacturers do not support the use of formaldehyde in tofu (80%).

Table 2: Overview of Tofu Seller in Jember.

	Frequency	Percentage (%)
Age group		
>60 years	2	8
51-60 years	5	21
41-50 years	10	42
< 40 years	7	29
Period of Selling		
>40 years	2	8
31-40 years	4	17
21-30 years	9	37
<20 years	5	21
	4	17
Education Level		
Ungraduated Primary School	2	8
Graduated Primary School	6	25
Graduated Junior High School	7	29
Graduated Senior High School	9	38
Income Average (Rp)/day		
10-100 /day	10	42
>100 /day	14	58
Impact of Giving BTM		
Yes	13	54
No	11	46
Attitudes towards the Use of Formalin in Tofu		
Supported	5	21
Not Supported	19	79

Source: Primary Data 2019

Most traders are in the age range of 40-50 years, which is 42%. The most length of business is 21-30 years which is 37% and the education level of most respondents is high school graduate 38%. Most traders' income > 100 thousand amounted to 58 and regarding the impact of BTM giving, most of them stated that they had an impact of around 54% of respondents. Attitudes toward the use of formaldehyde in tofu Most of the traders do not support the use of formaldehyde in tofu (79%).

Differences in Formalin Levels in White Tofu at the Producer and Trader Level Qualitative test results using Formalin Test Kit show that all tofu samples at the producer level do not contain formaldehyde. A total of 2 tofu samples (8.3%) at the level of traders positively contained formaldehyde. All producers realize that the use of formalin in food is not permitted. Sudden operations are also often carried out on tofu home industries in Kaliwates District. If during a sudden operation is found out in formalin, the industry will be fined and stopped its production. This has led to

increased awareness of producers of the ban on the use of formalin to preserve food.

Positive tofu samples containing formaldehyde are then further tested to find out formaldehyde levels in tofu. Quantitative formalin testing used spectrophotometric methods. Quantitative test results can be seen in Table 3.

Table 3: Results of Examination of Formalin Levels of Tofu at Trader Level Qualitatively and Quantitatively in Jember Regency in 2019.

No	Sample Codes	Color	Qualitative Analysis	Quantitative Analysis
1.	KP1	White	Negatif	Not continued
2.	KP2	White	Negatif	Not continued
3.	KP3	White	Negatif	Not continued
4.	KP4	White	Negatif	Not continued
5.	KP5	White	Negatif	Not continued
6.	KP6	White	Negatif	Not continued
7.	KP7	White	Negatif	Not continued
8.	KP8	White	Negatif	Not continued
9.	KP9	White	Negatif	Not continued
10.	KP10	White	Negatif	Not continued
11.	TB1	White	Negatif	Not continued
12.	TB2	White	Negatif	Not continued
13.	TB3	White	Negatif	Not continued
14.	TB4	White	Negatif	Not continued
15.	TJ1	White	Negatif	Not continued
16.	TJ2	White	Negatif	Not continued
17.	TJ3	White	Negatif	Not continued
18.	TJ4	White	Negatif	Not continued
19.	TJ5	Purple	Positif	4.2 ppm
20.	TJ6	White	Negatif	Not continued
21.	TJ7	White	Negatif	Not continued
22.	TJ8	White	Negatif	Not continued
23.	TJ9	Purple	Positif	4.8 ppm
24.	TJ10	White	Negatif	Not continued

Source: Primary Data 2019

Formalin levels in samples varied between 4.2-4.8 ppm. The highest formaldehyde content was in the TJ9 sample which was 4.8 ppm. The average formaldehyde content in the positive sample was 4.6 ppm. Tofu with positive formaldehyde content is found in traders. This is consistent with the results of interviews about the impact of BTM on tofu showing that the category of not knowing about BTM administration is still quite large (46%). It is also stated that all tofu samples at the producer level did not contain formaldehyde and 26% of tofu samples taken from traders in the traditional wholesale market in Semarang City were positive containing formaldehyde with formaldehyde in the samples varied between 1.55-5049.91 ppm.^[4]

Knowledge can be influenced by education, work, age, interests, experience, culture and information.^[17] Knowledge can be increased through counseling or providing information.^[19] Some traders have participated in counseling related to the prohibition on the use of formaldehyde which can increase traders' knowledge about the dangers of formaldehyde. This increase in knowledge tends to increase awareness and result in an increase in trader behavior towards a better direction. According to the European Food Safety

Authorities threshold for formalin in the body comes from food is 1.4-1.7 mg / KgBB / day for people weighing 60-70 Kg. Acceptable Daily Intake (ADI) formalin is 4 mg / KgBB / day.^[11] If it exceeds this threshold, it can cause poisoning for people who consume it.

Differences in Formalin Levels in White Tofu Based on Storage Time

Tofu storage time testing of formaldehyde content was carried out by giving treatment to white tofu that was known to be positive containing formaldehyde from one of the merchant samples. The sample was divided into four groups, namely one control group (K) and three treatment groups (X1, X2, and X3). The control group (K) is formalin tofu that is not stored in water. The first treatment group (X1) is tofu formalin stored in water for 24 hours, the second treatment group (X2) is tofu formalin stored in water for 48 hours and the third treatment group (X3) is tofu formalin stored in water for 72 hours.

The observations showed that there was a decrease in formaldehyde levels in tofu between the treatment groups with each other, which can be seen in Table 4.

Table 4 Average Decrease in Formalin Levels in Each Study Group.

No	Treatment	Control (ppm)	Average of Formaldehyde Level in Each Treatment (ppm)	Percentage of Decrease in Formalin Levels
1	X1	4,8	4,7	2,08
2	X2	4,8	4,26	11,25
3	X3	4,8	3,78	21,25

X1 Formalin Tofu Kept in Water 24 hours; X2 Formalin Tofu Kept in Water 48 hours; X3 Formalin Tofu Kept in Water 72 hours.

Table 4 shows that the treatment group had varying ability to reduce formaldehyde levels. Decrease in formalin levels in tofu with storage in water for 24 hours, 48 hours, and 72 hours can be seen in the graph below.

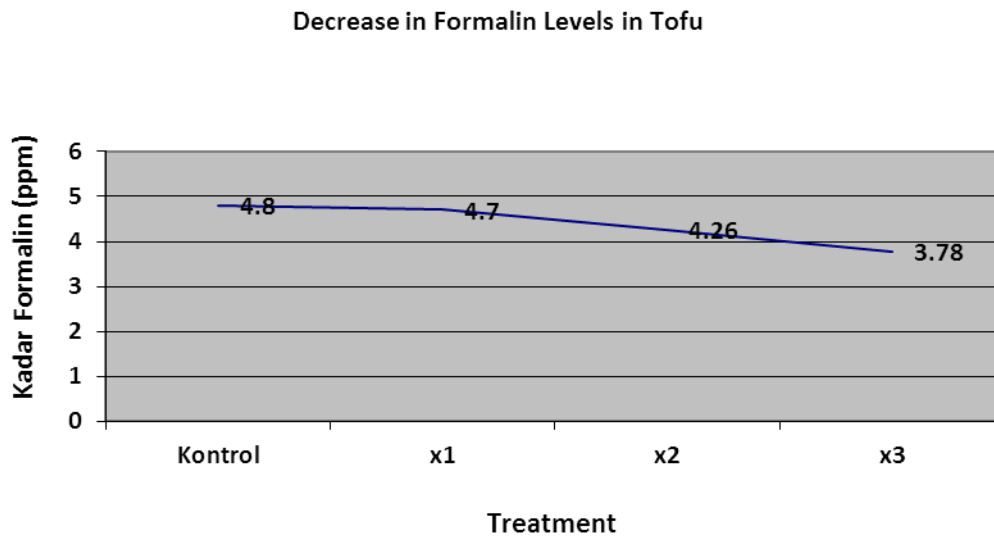


Figure 1: Decrease in Formalin Levels in Tofu Storage for 24 Hours, 48 Hours and 72 Hours.

The highest decrease in formaldehyde levels occurred in group X3 with the ability to reduce formaldehyde levels by 21.25%, while the lowest ability to reduce formaldehyde levels occurred in group X1 with the ability to reduce formaldehyde levels by 2.08%.

Formalin tofu storage time is negatively related to formaldehyde levels (Correlation coefficient -0.941). The longer the storage is carried out, the formalin levels in tofu decreases. Tofu storage time has an influence on formalin levels in tofu p value = 0,000 (p <0.005) and has a strong influence (R2 = 0.886). There is a very significant difference between the duration of tofu storage in water for 24 hours, 48 hours and 72 hours with the change in formaldehyde p value = 0,000 (p <0.05).

The storage time influences the levels of formaldehyde in tofu because when dissolved in formaldehyde water it will change to H2C (OH) 2. The nature of formaldehyde is volatile. At room temperature it is a gas with an unpleasant stimulating odor. This substance can be oxidized, reduced, adapted and can form secondary alcohols. The results of these volatile substances cause the longer storage of formalin in tofu tends to cause a decrease in formaldehyde in tofu. Decrease in formaldehyde levels in treatment with water as a heat-

conducting medium is due to the nature of formalin which is soluble in water. Formalin compounds have a CH2O group that easily binds to water and an aldehyde group that easily binds to proteins.^[26] This condition causes formalin in tofu to bind to water so that the formaldehyde content in tofu is reduced.

Soaking and boiling can reduce formaldehyde levels. Soaking tofu with salt water concentration of 1%, 3%, 5%, 7%, 9% during the 60 minute immersion time can reduce formalin levels respectively by 12.96 ± 0.81%; 28.69 ± 1.14%, 36.85 ± 0.22%, 57.62 ± 0.53%, 65.29 ± 0.40%.^[14] Boiling for 20 minutes without replacing the cooking water can reduce levels formalin in tofu up to 66%. Boiling the tofu for 20 minutes by replacing the cooking water every 5 minutes can reduce the levels of formalin in tofu by up to 75%.^[22]

CONCLUSION AND SUGGESTION

All samples at the producer level do not contain formaldehyde, while at the merchant level, 2 formaldehyde samples are obtained from 24 samples (8.3%) taken from white tofu traders in the traditional markets of Kaliwates Subdistrict, Jember Regency. Formalin levels in white tofu at merchant level varied from 4.2 to 4.8 ppm. No different levels of formaldehyde

content were tested at producer and trader tofu levels, because the formalin content of all white tofu samples at producer level was negative. There is an opposite relationship between the storage time of white tofu to the levels of formaldehyde (coefficient correlation -0,941) and there is a storage time effect on the levels of formaldehyde (p value 0,000). The most decrease occurred in tofu storage for 72 hours, amounting to 21.25%. While in tofu storage for 48 hours there was a decrease of 11.25% and in tofu storage for 24 hours there was a decrease of 2.08%.

BPOM and the Health Office need to conduct intensive and comprehensive counseling to producers and traders knowing about the dangers of formaldehyde and the prohibition of the use of formaldehyde in food. The community needs to understand the characteristics of formalin tofu that is durable up to 3 days at room temperature and > 15 days of refrigerator temperature, The tofu becomes hard, firm and has a rather pungent odor.

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