

Relationship Between Knowledge Level of White Tofu Traders and the Presence of Formalin in Kartasura Traditional Market, Sukoharjo Regency

Shofiyah Nabila¹, Rezaniasyfiradayati^{2*},

^{1,2} Prodi Kesehatan Masyarakat, Fakultas Ilmu Kesehatan, Universitas Muhammadiyah Surakarta

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ABSTRACT

Introduction: White tofu is an alternative food among the lower middle class that has the benefit of a fairly high vegetable protein content. The use of Formaldehyde in white tofu can be caused by the lack of knowledge of traders on the dangers of Formaldehyde. This study aims to determine the relationship between the level of knowledge of White Tofu Traders and the Presence of Formalin in the Kartasura Traditional Market, Sukoharjo Regency. **Methods:** This type of research is observational analysis with a cross-sectional approach. The research sample of 46 traders was taken using the simple random sampling technique. The interview used a questionnaire containing 18 multiple-choice questions. Qualitative test of Formaldehyde content using Potassium permanganate (KMnO₄). Statistical analysis uses the chi-square test with a significance of 0.05. **Results:** The study found that 46 negative tofu samples were characterized by no color change from purplish ash to brownish. The results of the Chi-square test analysis obtained a p-value or sig. of 0.228, using an alpha of 0.05, the p-value ≥ 0.05 or a calculated χ^2 value of $1.660 \leq \chi^2$ table of 3.841 was obtained. **Conclusion:** It can be concluded that there is no relationship between the level of knowledge and the presence of formalin in the Kartasura traditional market, Sukoharjo Regency.

Corresponding Authors: (*)

Prodi Kesehatan Masyarakat, Fakultas Ilmu Kesehatan, Universitas Muhammadiyah Surakarta, Surakarta, Jl. A. Yani Tromol Pos I, Pabelan Kartasura, Sukoharjo 57169, Indonesia

Email: rezania.asyfiradayati@ums.ac.id

INTRODUCTION

Tofu is one of the processed foods made mainly from soybeans that is popular among the public. Cao, *et al* (2017) argue that Tofu has a highwater content and vegetable protein, which is 86%and 8-12%, respectively. Tofu can also be easily obtained on the market at a low price. Based on research conducted by Rahmawati (2022), it shows that 10% of Indonesia's population consumes as much as 100 grams of tofu per day. According to Ullah *et al* (2019) Tofu itself is produced through several natural stages such as grinding,

taking soybean starch juice and then printing. This type of processed food has variations such as white tofu, round tofu, and yellow tofu (Khanif dan Mahmudiono 2023). The process of making tofu generally does not involve medicinal chemicals (BKO), but there are some people who still use harmful BKO such as Formaldehyde.

Novita dan Hidayat, (2021) When formalin enters through the digestive tract, it will cause severe pain accompanied by inflammation and necrosis in the stomach, if the consumption is higher, it will result in death. Aziza *et al* (2017) argue that the dangers of using formalin for health are divided into two categories, direct exposure and long-term exposure. It can directly interfere with the respiratory tract such as coughing, strep throat and chest pain accompanied by irritation, allergies, nausea, vomiting, burning, abdominal pain and dizziness, while long-term exposure results in severe irritation, watery eyes, disorders in digestion, liver, kidneys, pancreas, central nervous system and causes cancer. Consuming foodstuffs that contain formalin, the side effects are seen after a long term, because there is an accumulation of formalin in the body.

The findings Lu *et al* (2022) and Wuisan *et al* (2020) stated that Formaldehyde is prone to be added to foods such as tofu, fish, meat, noodles and various types of packaged foods. Hayat and Darusmini (2021) stated that the results of research in the traditional market in cities in Indonesia found that there was formalin content in tofu. Research in Semarang showed that 26% of tofu containing Formaldehyde was at the trader level (Aziza *et al.*, 2017). The results of Nasution (2020) research in Pangkal Pinang City, market found the presence of Formaldehyde in 30% of the tofu samples tested. A study in the traditional market of Banjarmasin City found that as many as 66.6% of raw tofu samples contained Formaldehyde. The use of formalin as a preservative by tofu traders can be caused by traders' attitudes towards food additives and lack of knowledge about the dangers of Formaldehyde (Chen *et al.*, 2023, and Lu *et al.*, 2022).

Li *et al* (2015) stated that the free use of Formaldehyde in food, especially white tofu, is due to the lack of supervision by the apparatus and related agencies on the sale and circulation of Formaldehyde in the market and also the condition of a large area, the number of consumers who buy, and the lack of counseling held by related agencies on the dangers of Formaldehyde use. This proves that traders or producers lack knowledge (Ridwan *et al.*, 2021). Knowledge is the main capital in determining the attitude of traders in the use of Formaldehyde in the food they sell (Zulaekah *et al.*, 2023). Knowledge is a collection of information possessed by an individual or group through all processes, any whether innate or achieved based on experience (Khanif and Mahmudiono, 2023). Education is one of the factors that affect a person's knowledge (Dwinanda *dkk.*, 2017). Knowledge is very closely related to education, where it is hoped that with high education, a person will have a wider range of knowledge (Purwaningsih *et al.*, 2022).

The preliminary study was conducted by interviews and Formaldehyde testing on tofu on 10 traders in three Sukoharjo Traditional Markets including Gowak Market, Nongko Market and Carikan Market with the type of tofu studied, namely white tofu due to its high protein content so that it is easily damaged due to microbial activity. It is known that 8 people do not know the characteristics of Formaldehyde-based tofu, including Gowak Market 1 person, Cari Market 4 people, Nongko Market 3 people. In addition, from the 10 tofu samples examined, 3 positive results were obtained containing formalin. 1 positive result in Gowak Market and 2 positive results in Nongko Market. Based on the above facts and problems, the researcher is interested in researching the knowledge of white tofu traders with the presence of Formaldehyde content in the Kartasura Traditional Market, Sukoharjo Regency.

LITERATURE REVIEW

Prayogo *et al* (2023) stated that Formaldehyde is a chemical substance that is harmful to health for body cells and can cause poisoning. According to (Sulistyorini *et al.*, 2022) the high content of Formaldehyde absorbed in the body can cause irritation of the stomach, allergies to the skin and cause cancer. The results of research by the International Agency for Cancer (IARC) have classified formalin as a carcinogenic substance that can spread through the respiratory tract. According to (Kuswandi *et al.*, 2018) Bambang Formalin can naturally be found in foods up to 300-400 ppm including in fruits, vegetables, meat, tofu and marine fish. Naturally occurring levels of Formaldehyde can vary depending on the type and condition of the diet. The results of the previous research found several types of fruits that have natural Formaldehyde content such as apples, bananas, watermelons, and grapes (Nowshad *et al.*, 2018 and Wahed *et al.*, 2016).

Previous study showed that formalin does not accumulate in the human body because it is quickly broken down by the body's natural metabolic processes (Meihua Qu, Jing Lu, 2017). Once in the body, formalin is quickly broken down into other chemicals. Most of these chemicals quickly leave the body through the urine. According to Reingruber and Pontel (2018) Formaldehyde can be converted to carbon dioxide and excreted by the body through respiration. Meanwhile, according to Salthammer (2019) Formaldehyde can quickly decompose in the air when exposed to sunlight or bacteria and has a pungent smell so that it can cause irritation of the eyes and digestive tract at high concentrations.

Based on the standards of the European Food Safety Authority (EFSA), the maximum limit of Formaldehyde allowed to be consumed in food is 100 ppm (parts per million), which is 100 mg/kg of food per person per day. This regulation is in line with the provisions set by the Food and Drug Supervisory Agency (BPOM) in Indonesia (Decree of the Food and Drug Supervisory Agency Regulation Number 34 of 2019 concerning Food Categories) The list of preservatives allowed to be used in food with requirements for Formaldehyde tolerance limits is recorded at 0.016 ppm. If consumed at excessive concentrations of these limits, formalin can cause damage to the digestive tract such as the kidneys, liver and lungs, and can even cause cancer. The use of Formaldehyde in white tofu is also very dangerous because Formaldehyde is an unsafe ingredient to consume. Formaldehyde is a solution of formaldehyde in water, which is used in industry to preserve corpses, wood, and various other products. The use of Formaldehyde in white tofu is carried out illegally to extend the shelf life of the product.

METHOD

This study employs a quantitative descriptive method aimed at identifying the relationship between dependent and independent variables using an explanatory research approach. A survey was used as the research method to collect factual and systematic information from the research subjects. To analyze the data, a simple regression analysis was applied to determine whether there is a relationship between the level of knowledge of white tofu traders and the presence of formalin in traditional markets in Kartasura, Sukoharjo Regency.

The research was conducted from December 2023 to March 2024 at several traditional markets in Kartasura, Sukoharjo Regency. The study population consisted of 87 white tofu traders. The criteria for determining the population included: (1) population type—only traders with fixed selling locations were included, while mobile sellers were excluded; (2) demographic factors such as age, gender, ethnicity, and education level, which allowed for a more comprehensive understanding of the population's diversity; and

(3) geographical factors such as the location and distribution of tofu sellers, providing insight into spatial contexts that may influence the study's results.

The sample was selected using a simple random sampling technique, yielding 46 traders from four traditional markets: Krangan Wirogunan Market, Bumirejo Market, and Kartasura Market. Sampling was conducted via a lottery system, and the selected traders became the study's respondents. Their knowledge levels were assessed through a structured questionnaire, and their tofu products were tested for formalin content.

The independent variable in this study was the traders' knowledge regarding the dangers of formaldehyde as a food additive. Data were collected through direct interviews using a questionnaire consisting of 18 multiple-choice questions. The questionnaire was administered to each respondent to measure their level of understanding.

To support the formalin testing, the tools used in the study included test tubes, measuring cups, mouthpieces, test tube racks, droppers, and spatulas. The materials used consisted of 46 tofu samples, 0.1 N KMnO_4 solution (3 to 5 drops per sample), and distilled water (aquades).

RESULT AND DISCUSSION

This research was conducted on traders who sell white tofu in four traditional markets of Kartasura Sukoharjo Regency, namely the Krangan Wirogunan Market, Kleco Market, Bumirejo Market and Kartasura Market which totaled 46 tofu samples per respondent. The characteristics of the respondents in this study are as follows:

Table 1. Characteristics of Respondents in the Regency Traditional Market
Kartasura Sukoharjo (N= 46)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	7	15.2
Woman	39	84.8
Respondent age		
Adolescent 25-45 years	12	26.1
Adult 46-56 years	34	73.9
Educational		
Uneducated	7	15.2
primary school	10	21.7
Junior High School	8	17.3
High School	21	45.8
Level of Knowledge		
Not Good	42	91.4
Keep	2	4.3
Good	2	4.3

Based on table 1, it shows that of the 46 respondents who were the majority of the research samples, 39 people were female with 84.8%. Then based on age, it was obtained that the largest number of respondents were 46-56 years old, each with a total number, namely 34 people with a percentage of 73.9%. Then the most respondents had a high school/vocational school background of 21 people with a percentage of 45.8%. Most of the respondents with a good level of knowledge pursued final education at the high school level. According to (Dwinanda et al., 2017), the higher a person's education level, the easier it will be for the person to receive information. A person's level of education affects a person's perception to accept new ideas or ideas and technologies.

Based on table 1, it is known that the answers of respondents who have poor knowledge are 42 people with an answer percentage of 91.4%, respondents who have moderate knowledge are 2 people or 4.3%, and respondents who have good knowledge are 2 people or 4.3%.

In table 3 Formalin Content Test using Potassium Permanganate (KMnO₄) Observation of 46 tofu samples without formalin detection can be seen that all tofu samples are negative, no formalin detection can be found by no color change that occurs from purplish ash to brownish after reacting by dripping 3 to 5 drops of KMnO₄ in each sample. Some white tofu that contains formalin has characteristics that can be distinguished from tofu that does not contain formalin, tofu that contains formalin has characteristics such as chewiness when pressed, not easily destroyed, not easily damaged or not easily rotten and lasts longer. The misuse of harmful chemicals as additives for food and beverage products that are not in accordance with their intended purpose has caused a lot of anxiety in the community.

Table 3. The results of the sample test by qualitative test method using KMnO₄ Reaction

Sample code	Sample	Observation	Observations		
			Observ. I	Observ. II	Observ. III
Negative Control			(-)	(-)	(-)
A1	Purplish Ash	Brownish Color	(-)	(-)	(-)
A2	Purplish Ash	Brownish Color	(-)	(-)	(-)
A3	Purplish Ash	Brownish Color	(-)	(-)	(-)
A4	Purplish Ash	Brownish Color	(-)	(-)	(-)
A5	Purplish Ash	Brownish Color	(-)	(-)	(-)
A6	Purplish Ash	Brownish Color	(-)	(-)	(-)
A7	Purplish Ash	Brownish Color	(-)	(-)	(-)
A8	Purplish Ash	Brownish Color	(-)	(-)	(-)
A9	Purplish Ash	Brownish Color	(-)	(-)	(-)
A10	Purplish Ash	Brownish Color	(-)	(-)	(-)
A11	Purplish Ash	Brownish Color	(-)	(-)	(-)
A12	Purplish Ash	Brownish Color	(-)	(-)	(-)
B1	Purplish Ash	Brownish Color	(-)	(-)	(-)
B2	Purplish Ash	Brownish Color	(-)	(-)	(-)
B3	Purplish Ash	Brownish Color	(-)	(-)	(-)
B4	Purplish Ash	Brownish Color	(-)	(-)	(-)
B5	Purplish Ash	Brownish Color	(-)	(-)	(-)
B6	Purplish Ash	Brownish Color	(-)	(-)	(-)
B7	Purplish Ash	Brownish Color	(-)	(-)	(-)
B8	Purplish Ash	Brownish Color	(-)	(-)	(-)
B9	Purplish Ash	Brownish Color	(-)	(-)	(-)
B10	Purplish Ash	Brownish Color	(-)	(-)	(-)
B11	Purplish Ash	Brownish Color	(-)	(-)	(-)
C1	Purplish Ash	Brownish Color	(-)	(-)	(-)
C2	Purplish Ash	Brownish Color	(-)	(-)	(-)
C3	Purplish Ash	Brownish Color	(-)	(-)	(-)
C4	Purplish Ash	Brownish Color	(-)	(-)	(-)
C5	Purplish Ash	Brownish Color	(-)	(-)	(-)
C6	Purplish Ash	Brownish Color	(-)	(-)	(-)
C7	Purplish Ash	Brownish Color	(-)	(-)	(-)
C8	Purplish Ash	Brownish Color	(-)	(-)	(-)
C9	Purplish Ash	Brownish Color	(-)	(-)	(-)
C10	Purplish Ash	Brownish Color	(-)	(-)	(-)

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Table 3. The results of the sample test by qualitative test method using KMnO₄ Reaction

Sample code	Sample	Observation	Observations		
			Observ. I (-)	Observ. II (-)	Observ. III (-)
Sample Negative Control					
C11	Purplish Ash	Brownish Color	(-)	(-)	(-)
D1	Purplish Ash	Brownish Color	(-)	(-)	(-)
D2	Purplish Ash	Brownish Color	(-)	(-)	(-)
D3	Purplish Ash	Brownish Color	(-)	(-)	(-)
D4	Purplish Ash	Brownish Color	(-)	(-)	(-)
D5	Purplish Ash	Brownish Color	(-)	(-)	(-)
D6	Purplish Ash	Brownish Color	(-)	(-)	(-)
D7	Purplish Ash	Brownish Color	(-)	(-)	(-)
D8	Purplish Ash	Brownish Color	(-)	(-)	(-)
D9	Purplish Ash	Brownish Color	(-)	(-)	(-)
D10	Purplish Ash	Brownish Color	(-)	(-)	(-)
D11	Purplish Ash	Brownish Color	(-)	(-)	(-)
D12	Purplish Ash	Brownish Color	(-)	(-)	(-)

The use of chemicals such as dyes, preservatives, and formalin for food or foodstuffs is carried out by irresponsible persons. They do such things so that the processed becomes more durable and also of course more economical so that it is expected to generate the greatest profit. However, the health impacts caused by the use of these hazardous substances are very bad for the people who consume them. The use of formalin in white tofu is not justified as a food preservative and has long been prohibited by the government, this statement is guided by the regulation of the Minister of Health of the Republic of Indonesia No.722/Menkes/Per/IX/2012.

The Relationship between the Knowledge Level of White Tofu Traders and the Presence of Formalin

In this study, a simple linear regression analysis method was used to determine the value prediction of the bound variable, namely the presence of formalin (Y) by calculating the independent variable, namely the trader's knowledge level (X). Result statistic from analysis (Table 4).

Based on the table above, it can be seen that the value of thitung and sig can be explained as follows: The knowledge of traders is positively and significantly related to the existence of formalin in the traditional market of Kartasura Sukoharjo Regency. This is seen to be significant variable trader knowledge $0.006 < 0.05$. And the tcal value is 2.836 with a Sig value of 0.000. Thus H₀ is rejected and H₁ is accepted. This means that the trader's knowledge is partially related to the existence of formalin in the traditional market of Kartasura Sukoharjo Regency. Furthermore, the researcher will test the correlation coefficient of the relationship between traders' knowledge and the presence of formalin. The results of the Correlation Coefficient between traders' knowledge and the presence of formalin in the traditional market of Kartasura Sukoharjo Regency are in Table 5.

Then the minimum expected value is 14.06, meaning there is no expected value smaller than 5, so the Chi-square test requirements are met. From the results of the Chi-square test analysis, the p-value or sig. is 0.228, using an alpha of 0.05, the p-value ≥ 0.05 or the calculated χ^2 value is $1.660 \leq \chi^2$ table of 3.841. Thus, there is not enough data to accept H₁. This means that H₀ is accepted, thus it can be interpreted that there is no relationship between the level of knowledge and the presence of formalin in the Kartasura traditional market, Sukoharjo Regency.

Table 5. Chi-Square test value of knowledge level with the presence of formalin

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	1,660(b)	1	0,159	
Continuity Correction(a)	1,426	1	0,228	
Likelihood Ratio	1,673	1	0,120	
Fisher's Exact Test				0,215
Linear-by-Linear Association	1,676	1	0,120	
N of Valid Cases	87			

These results show that there is a positive relationship in the weak category between traders' knowledge and the presence of formalin. So that this proves the opinion of research (Nazal et al., 2022) proving that the use of formalin in white tofu products is often consumed by the community and is not justified in Wongsorejo District. This is in line with the research conducted (Aziza et al., 2017) stating that there is a relationship between the existence of formalin at the producer and trader level in the city of Semarang. This research is also in line with research conducted by (Khanif dan Mahmudiono, 2023) stating that there is a relationship between traders' knowledge and formalin content in white tofu at the Surabaya Traditional Market.

Nirmala sari et al., (2022) stated that the effects of consuming formalin in the long term include allergies, irritation, watery eyes, dizziness, nausea, vomiting, redness of the skin, tightness, heart disease, abdominal pain and diarrhea. Formalin consumed in the long term can also cause disorders of the liver, digestion, pancreas, kidneys, central nervous system, menstruation, and is carcinogenic. Puspardini & Triyanto, (2018) also argued in their research that the administration of formalin to white tofu resulted in a significant effect on uterine weight loss as well as a decrease in endometrial thickness, epithelial thickness, and also a decrease in the diameter of blood vessels. Tofu sold at traditional markets in Kartasura Sukoharjo District is safe for consumption because there is no indication of formalin contamination, but it is necessary to test other additives such as borax.

Based on the International Programme on Chemical Safety (IPCS), the allowable tolerance limit of formalin is 0.1 mg per liter or in one day the allowable intake is 0.2 mg. While the formalin that can enter the body in food form for adults is 1.5 mg to 14 mg per day. There is a difference between the Government of Indonesia, in this case the Ministry of Health and food safety institutions in Europe, perhaps because human resources and facilities in Indonesia are inadequate and well controlled, do not have analytical scales or instruments in making dilution of a chemical solution in the addition of food ingredients such as white tofu. Formalin is used extensively in an unethical way to extend the shelf life of tofu during the storage process. Since these substances are harmful to human health, there is a need for the development of technologies that are more suitable for the protection of human health. Public awareness must be raised about the harmful effects of formalin.

CONCLUSION

Based on the results of the study conducted at the Kartasura Sukoharjo Traditional Market in December 2023 to March 2024 on 87 white tofu traders using three to five drops of KMnO_4 , all tofu samples were negative for containing formalin. The results of the Chi-square test analysis obtained a p-value or sig. of 0.228, using an alpha of 0.05, the p-value \geq

0.05 or a calculated χ^2 value of $1.660 \leq \chi^2$ table of 3.841 was obtained, it can be concluded that there is no relationship between the level of knowledge and the presence of formalin in the Kartasura traditional market, Sukoharjo Regency.

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