TROPICAL PUBLIC HEALTH JOURNAL
Journal homepage: https://talenta.usu.ac.id/trophico

Qualitative test of formalin content in Hainanese Chicken Rice in Tanjungpinang City Area

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ARTICLE INFO

Article history:
Received 8 October 2025
Revised 24 October 2025
Accepted 05 December 2025
Published 06 December 2025
Available online
https://talenta.usu.ac.id/trophico

E-ISSN: 2797-751X
P-ISSN: 2774-7662

How to cite:
Zaleha, Simbolon, VA. Erda, Z. (2025). Qualitative Test of Formalin Content in Hainanese Chicken Rice in Tanjungpinang City Area. *Tropical Public Health Journal*, *5*(2), 71-77.

http://doi.org/10.32734/trophico.v5i2.23036

ABSTRACT

Food safety is an important issue in Indonesia that is often associated with cases of food poisoning, one of which is due to the use of banned Food Additives (BTP) such as formalin. The people of Tanjungpinang City consume a lot of processed chicken meat, such as Hainanese chicken rice, so it is important to ensure its quality and safety. This study aims to identify the organoleptic physical quality of chicken meat and detect the presence of formalin in Hainanese chicken rice. This type of research is descriptive qualitative with an observational approach. The study population included all Hainanese chicken rice traders in Tanjungpinang City as many as 51 people, and all were sampled (total sampling). The physical examination of chicken meat was conducted organoleptically, while the formalin content test used potassium permanganate solution ($KMnO_4$). Results showed that formalin-positive chicken meat is characterized by its off-white color, pungent odor, and chewy texture. Of the 51 samples tested, 11 showed positive results for formalin, indicated by a change in color to cloudy yellow or brown. Meanwhile, negative samples showed a pink color with no significant color change. These findings emphasize the importance of monitoring the use of formaldehyde in ready-to-eat food.

Keywords: *Formalin, Hainanese Chicken Rice, Food Safety, Organoleptic Test, $KMnO_4$*

1. Introduction

Food safety is still one of the major public health concerns in Indonesia, often characterized by incidents of food poisoning. One of the main contributing factors to such cases is the excessive use of food additives that exceed the permitted limits. Based on the Regulation of the Minister of Health of the Republic of Indonesia No. 033/2012 on Food Additives, there are several types of additives that are prohibited from being used in food products, including formalin (Permenkes RI, 2012).

The World Health Organization (WHO) estimates that around 600 million cases of food-borne illness occur annually worldwide, caused by bacteria, viruses, parasites, as well as the use of harmful additives. Data from Indonesia's Food and Drug Monitoring Agency (BPOM) in 2022 recorded 72 extraordinary events (KLB) in the food sector. The incident involved 5,505 people exposed to contaminated food, of which 2,788 showed symptoms of food poisoning, and five people were reported dead (Data Indonesia, 2023). In addition, the Riau Islands Provincial Health Office reported as many as 2,959 cases of food-borne illness in the school environment in 2015 (Riau Island Provincial Health Office, 2018).

Food-borne illnesses can result from the use of harmful additives such as boric acid, salicylic acid, potassium chlorate and formalin. Among these ingredients, formalin is the most dangerous due to its toxic properties. Repeated exposure to formalin can cause serious health problems, including damage to vital organs such as the liver, kidneys, spleen, pancreas and brain (Hadiwiyoto, 2014). The continued presence of formalin in food products emphasizes the importance of stricter monitoring and regulation. The detection of formalin in food samples can be done through a qualitative test using potassium permanganate ($KMnO_4$). When $KMnO_4$ is added to a sample containing formaldehyde, a characteristic color change will occur, from purple or pink to

cloudy yellow or reddish, indicating a positive result (Kiroh et al., 2019). Formalin is often used irresponsibly by some traders to preserve food that is not sold out.

The rise of culinary business trends, especially the sale of snacks and side dishes, requires business actors to be able to manage food ingredients hygienically and appropriately, with the aim of avoiding the risk of food-borne diseases. Among the various types of culinary available, chicken-based preparations are one of the most popular in the community because of their delicious taste and ease of processing into various menus. One of the most popular chicken-based dishes is Hainanese chicken rice. This dish consists of rice with fragrant and savory spices, served with tender chicken pieces and a distinctive complementary sauce. Hainanese chicken rice has become one of the favorite foods of the people in Tanjungpinang City, not only by the ethnic Chinese community, but also by various groups from other ethnicities because of its delicious taste, distinctive aroma, and simple but appetizing presentation. The popularity of this dish is not only driven by its savory and appetizing taste, but also by its relatively affordable price, making it easily accessible to various groups of people.

The high interest in these foods has raised concerns about their safety. Under conditions of increasingly fierce culinary business competition, some unscrupulous business people are suspected of engaging in fraudulent practices by adding hazardous food additives that should not be used in food. These actions are generally aimed at extending the shelf life or maintaining the appearance of food to keep it attractive, but can actually pose a serious risk to consumer health. One of the hazardous ingredients that is often misused as a preservative is formalin. Research conducted by Kristiani et al., (2020) at the STIKES Wira Husada Yogyakarta Campus Laboratory showed that of 27 broiler chicken samples sold in traditional markets, 6 samples tested positive (+) for formalin, while all samples from modern markets tested negative (-), or did not contain formalin compounds. The test was conducted using $FeCl_3$ reagent. Another study of 10 samples of slaughtered chicken from the Old Market, Banjarmasin Region, showed that 30% of the samples were negative for formalin and 70% of the samples were positive for formalin (Ayuchecaria et al., 2017).

Preliminary identification results of chicken rice samples from three traders in Tanjungpinang City showed that one of the three samples tested positive for formalin. The examination was conducted at the Chemistry and Microbiology Laboratory of the Polytechnic of the Ministry of Health in Tanjungpinang using the potassium permanganate ($KMnO_4$) solution test method. This finding raises concerns regarding the practice of using banned hazardous chemicals in food products, especially in Hainanese chicken rice dishes. Based on this background, the researcher considers it necessary to conduct a study entitled "Qualitative Test of Formalin Content in Hainanese Chicken Rice in Tanjungpinang City Area" as an effort to support food safety supervision and public health protection.

2. Methods

The type of research used in this study is descriptive qualitative research which aims to describe, illustrate, and explain the presence of formaldehyde in Hainanese rice chicken meat samples. The research design used was observational design. This research was conducted at the Chemistry and Microbiology Laboratory of the Polytechnic of the Ministry of Health in Tanjungpinang and at all Hainanese chicken rice stalls in the Tanjungpinang City area. The research activities lasted for six months, from January to June 2024.

The population in this study consisted of all Hainanese chicken rice stalls in Tanjungpinang City, totaling 51 stalls. The research sample was chicken meat obtained from these stalls, using a **total sampling method**. Samples were collected directly from each stall, placed in labeled Ziplock plastic bags containing identification, date, and time of collection, and then stored in a **cooler box** for transportation to the laboratory. The testing solution used was **potassium permanganate ($KMnO_4$)** with a concentration of **0.316% (w/v)** or approximately **0.02 M**, prepared by dissolving **0.79 g of $KMnO_4$ in 250 ml of deionized water**. The testing procedure involved **grinding and homogenizing** 25 grams of chicken meat using a mortar, wrapping it in gauze, placing it on a funnel with a filter, and adding **30 ml of distilled water** to extract the sample. The filtrate was collected in a measuring cylinder, and **5 ml** of the extract was transferred into a test tube. Then, **five drops of $KMnO_4$ solution** were added, and **color changes were observed after 30 minutes at room temperature (±27°C)**. The criteria for test results were defined as follows: samples were considered **negative** if no color change occurred (remaining purple, pink, or reddish-brown), and **positive** if the color changed to colorless or clear white.

3. Results

This study used potassium permanganate ($KMnO_4$) solution to test the presence of formalin in Hainanese chicken rice samples. $KMnO_4$ solution was prepared by dissolving $KMnO_4$ powder in distilled water until homogeneous, then used to detect formalin through color changes in the samples. A total of 51 chicken

meat samples were obtained from Hainanese chicken rice traders spread across four sub-districts in Tanjungpinang City, namely Tanjungpinang Kota, Tanjungpinang Barat, Tanjungpinang Timur, and Bukit Bestari sub-districts. Samples were taken from various types of establishments, including street vendors, restaurants and coffee shops. The sampling process was conducted in the morning, afternoon and evening, with 50 samples tested on the same day and 1 sample tested the next day.

Initial identification was done through organoleptic tests to assess the physical characteristics of chicken meat, including odor, color, and texture. Next, formalin testing was conducted by dropping $KMnO_4$ solution on chicken meat samples that had been mixed with distilled water. The sample was tested positive for formalin if the purple color of the $KMnO_4$ solution turned clear, cloudy yellow, or brown after 30 minutes. To ensure the validity of the results, a positive control test was conducted by adding formalin to chicken meat as a comparison. Chicken meat containing formaldehyde showed an off-white color, while chicken meat that did not contain formaldehyde (negative) appeared white-brown in color. The difference in organoleptic characteristics between formalin-positive and formalin-negative Hainanese rice chicken meat is shown in the following figure:

Figure 1. Formalin Positive Chicken Meat Sample

Figure 2. Formalin Negative Chicken Meat Sample

Qualitative identification of formalin content in Hainanese chicken rice sold in various areas in Tanjungpinang City revealed findings that need serious attention. Out of 51 chicken meat samples taken from chicken rice vendors, 11 samples tested positive for formalin. This finding indicates that about 21.5% of the total Hainanese chicken rice samples tested contained hazardous chemicals that should not be used in food. The results of the chicken meat inspection can be seen in the following table:

Table 1. Formalin Content Test Results

Code	Physical Characteristics of Chicken Meat			Test Results		Source	Description
	Color	Odor	Texture	(-)	(+)		
A	Brownish White	Characteristic odor of chicken	Soft	Light Purple		Own Production	Negative
B	Pale white	More pungent	Somewhat chewy		Cloudy yellow	Manufacturer	Positive
C	Brownish White	Characteristic odor of chicken	Soft	Light Purple		Own Production	Negative
D	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
E	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
F	Pale white	More pungent	Somewhat chewy		Cloudy yellow	Own Production	Positive
G	Pale white	More pungent	Somewhat chewy		Cloudy yellow	Own Production	Positive
H	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
I	Pale white	More pungent	Somewhat Chewy		Cloudy yellow	Own Production	Positive
J	Brownish White	Characteristic odor of chicken	Soft	Brick red		Manufacturer	Negative
K	Pale white	More pungent	Somewhat chewy		Cloudy yellow	Own Production	Positive
L	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
M	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
N	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative

to be continued

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Table 1. Formalin Content Test Results *(continued)*

Code	Physical Characteristics of Chicken Meat			Test Results		Source	Description
	Color	Odor	Texture	(-)	(+)		
O	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
P	Pale white	More pungent	Somewhat chewy		Cloudy yellow	Own Production	Positive
Q	Pale white	More pungent	Somewhat chewy		Cloudy yellow	Own Production	Positive
R	Pale white	More pungent	Somewhat chewy		Brown	Own Production	Positive
S	Pale white	More pungent	Somewhat chewy		Brown	Manufacturer	Positive
T	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
U	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
V	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
W	Pale white	More pungent	Somewhat chewy		Brown	Own Production	Positive
X	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
Y	Pale white	More pungent	Somewhat chewy		Cloudy yellow	Own Production	Positive
Z	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
A1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
B1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
C1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Manufacturer	Negative
D1	Brownish White	Characteristic odor of chicken	Soft	Purple		Own Production	Negative
E1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
F1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
G1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
H1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
I1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
J1	Brownish White	Characteristic odor of chicken	Soft	Light red		Manufacturer	Negative
K1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
L1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
M1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
N1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
O1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
P1	Brownish White	Characteristic odor of chicken	Soft	Purple		Own Production	Negative
Q1	Brownish White	Characteristic odor of chicken	Soft	Purple		Manufacturer	Negative
R1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
S1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
T1	Brownish White	Characteristic odor of chicken	Soft	Purple		Manufacturer	Negative
U1	Brownish White	Characteristic odor of chicken	Soft	Purple		Manufacturer	Negative
V1	Brownish White	Characteristic odor of chicken	Soft	Light red		Own Production	Negative
W1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
X1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative
Y1	Brownish White	Characteristic odor of chicken	Soft	Brick red		Own Production	Negative

Source: Primary Data of Field Examination

4. Discussion

This study was conducted using a qualitative test that utilizes potassium permanganate ($KMnO_4$) solution as a formalin detection chemical. $KMnO_4$ powder dissolved in water will produce a violet purple solution. Potassium permanganate has various uses, one of which is as a reagent to detect the presence of formalin in food ingredients. The reaction between $KMnO_4$ and formalin produces a color change to clear, cloudy yellow, or brown, which occurs due to the oxidation process with the formation of manganese dioxide (MnO_2) precipitates as a result of the reaction (Marliza et al., 2019). The oxidation reaction that occurs when adding $KMnO_4$ solution to the sample serves to oxidize the formaldehyde contained in formalin. This process is characterized by a change in the color of the solution from purple to colorless (clear). The results of research conducted by Rambe et al., (2022) showed that four samples were positive for formaldehyde based on tests using $KMnO_4$ solution, which was marked by a change in the color of the sample to cloudy yellow. Research conducted by Sulthoniyah et al., (2022) also showed a similar reaction. After adding $KMnO_4$ solution, the solution turned a clear, light brown color, indicating the presence of formalin.

The existence of formalin content, convincingly confirmed by the results of this study and corroborated by previous research, collectively yields significant practical implications for the enforcement of food safety regulations in order to ensure the protection of public health. Specifically, the quantitative data regarding formalin levels in freely sold chicken samples in markets or retail outlets can serve as a strong basis for consideration by the Health Agency and other relevant institutions to immediately modify, strengthen, and implement stricter and more structured supervision strategies.

The validation test was conducted using chicken meat samples that were intentionally given formalin to serve as a positive control as shown in Figure 3.

Figure 3. Formalin Positive Control

Figure 4. Formalin Negative Control

4.1. Validation Test and Formalin Content Check Results

Chicken meat samples treated with formaldehyde showed a color change with the disappearance of the purple color of the $KMnO_4$ solution. This change indicates that the sample is positive for formalin. The reaction between $KMnO_4$ solution and formalin is characterized by a color change from purple to colorless (clear) after the solution reacts with the sample. Potassium permanganate ($KMnO_4$) is a strong oxidizer that oxidizes formaldehyde in formalin, so the purple color of $KMnO_4$ disappears after the sample is homogenized in a test tube (Khaira, 2015).

Based on the results of the examination of 51 (fifty-one) chicken meat samples, 11 (eleven) samples tested positive for formalin, which was indicated by the disappearance of the purple color of the $KMnO_4$ solution and turned cloudy yellow or brown. The use of $KMnO_4$ solution as a qualitative indicator to detect the presence of formalin in food, both cooked and uncooked, has been done by many researchers. Research by Jumrah et al., (2023) showed that all 5 (five) chicken meat samples tested were positive for formalin based on the color change of $KMnO_4$ solution which faded to white, brown, or returned to its original color before the addition of $KMnO_4$.

4.2. Organoleptic Test Results of Hainanese Rice Chicken Meat

Organoleptic observations were made to assess the physical characteristics of Hainanese rice chicken meat that was positive for formalin, including odor, color, and texture. The observation results show that chicken meat that is positive for formaldehyde has a pale white color. This happens because the base color of cooked chicken meat is white, and the addition of formalin causes the color to become paler. According to the Livestock Service Office (2017), chicken meat containing formalin is generally off-white due to the chemical reaction between the meat tissue and formalin.

Based on odor identification, formalin-positive chicken meat samples have a pungent aroma similar to the smell of medicine. This is due to the nature of formalin which has a distinctive and sharp odor. This

result is in line with the research of Zamaliq et al., (2020) which states that formalin chicken meat causes an unnatural aroma and is different from the typical smell of fresh meat in general.

The observation results in terms of texture, chicken meat containing formalin feels chewier than normal chicken meat. According to Sofyan et al., (2018), the water-soluble nature of formalin causes this compound to be easily absorbed into meat tissue. Formalin replaces intracellular fluid with a more rigid structure, causing the texture of the meat to become chewy and denser.

4.3. Color Analysis and Distribution of Formalin Positive Samples

The observation results shown in Table 1 indicate that 3 (three) chicken meat samples changed color to brown, while 8 (eight) other samples changed to cloudy yellow. The color change indicates the presence of formalin compounds in the samples. Before the test, the $KMnO_4$ solution was purple; after dropping it on the formalin-containing chicken meat samples, the color changed to brown or cloudy yellow.

This finding is in line with the results of Faoziyah et al., (2020) who explained that the color change occurs due to the presence of aldehyde functional groups in formalin which are more reactive than ketone groups. Aldehyde groups are easily oxidized into carboxylic groups by strong oxidizers such as $KMnO_4$. Conversely, if there is no color change in the sample, it means that the food does not contain formalin, because there is no substrate that can be oxidized by $KMnO_4$.

Of the eleven formalin-positive chicken meat samples, it was found that two of them came from traders who obtained their chicken meat supply from the same producer or agent. Based on interviews with Hainanese chicken rice traders, it was found that most were reluctant to provide further information on the source of supply of the chicken meat used. This raises the suspicion that some of the chicken meat on the market comes from distribution sources that are not well monitored.

4.4. Implications for Food Safety

The discovery of formalin-positive chicken meat in several Hainanese chicken rice vendors in Tanjungpinang City shows that there is still low awareness of food safety among businesses. Some traders allegedly use formalin as a preservative to extend the shelf life of chicken meat and prevent fly contamination, without considering the health impact on consumers.

The use of formaldehyde as a food preservative is strictly prohibited based on the Regulation of the Minister of Health of the Republic of Indonesia No. 033/2012 on Food Additives. Formalin is actually used in the medical world as a tissue or corpse preservative. Continuous exposure to formaldehyde can cause various serious health problems, such as damage to the liver, kidneys, spleen, pancreas and brain.

Formalin that enters the body through the digestive tract can cause irritation and react chemically with body cell components. If levels are high, it can suppress cell function, cause cell death, and trigger symptoms of acute poisoning. Therefore, the public needs to increase vigilance and be more selective in choosing foods that are safe for consumption (Directorate of Standardization, 2019).

5. Conclusion

The results showed that out of 51 samples of Hainanese rice chicken meat in Tanjungpinang City, 11 samples were positive for formalin as indicated by the change in color of $KMnO_4$ solution from purple to cloudy yellow or brown. Organoleptically, formalin-positive chicken meat has an off-white color, pungent odor, and chewier texture. These findings indicate that formalin is still used as a preservative in chicken meat, so further monitoring and education is needed to ensure public food safety.

6. Acknowledgement

My thanks to all those who have helped in completing this research until it can be continued at the publication stage.

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