IDENTIFICATION OF CHLORINE CONTENT (Cl_2) IN BULK RICE SOLD IN NORTH SURABAYA AREA

Yulia Puspa Mega[1], Baterun Kunsah[2*], Diah Ariana[3], Siti Mardiyah[4], Nastiti Kartikorini[5]

[1,2,3,4,5] D3 Medical laboratory technology, Faculty of Health Sciences, University of Muhammadiyah Surabaya, Indonesia

Corresponding author: kunsah11@um-surabaya.ac.id

Abstract. Rice (Oryza sativa) has remained one of the most important food sources, dating back to a time before the recording of history began. Food is a critical substance necessary for the human body and an essential element for human life. The primary functions of food are as an energy source and for building new body tissues. However, in this regard, many traders add hazardous chemical additives, such as bleach, as food additives, which is a cause for concern among consumers due to their potentially harmful effects. Therefore, the use of these chemicals is a significant concern for consumers because of their highly dangerous effects. The aim of this research is to determine the presence of chlorine (Cl_2) content in bulk rice. This study is descriptive in nature and involves calculating positive (+) and negative (-) percentages. The research method employed for this study is the Iodometric test. The research findings indicate that there are 3 samples containing the chemical chlorine, but the chlorine levels in these samples do not exceed the Food and Drug Administration (FDA) standards, or they are considered positive (+). Additionally, 16 samples do not contain chlorine or are negative (-), accounting for 84.21% of the total samples. Therefore, it can be concluded that the chlorine content in the 3 bulk rice samples is 15.79%, which does not exceed the FDA standards.

Keywords: Rice, Food Additives, Chlorine, North Surabaya

1 BACKGROUND

Rice (Oryza sativa) is a staple food crop that can be found and grown on almost every continent worldwide (Mohidem at al, 2022). To date, rice remains one of the crucial food sources, even dating back to a time before the recording of history began. A center of rice cultivation is estimated to be around Southeast Asia, including Indonesia, Indo-China, and South China, with other regions such as Africa, Europe, and the Mediterranean (Raharja et al., 2020).

Rice is the primary staple food for the majority of people in Indonesia (Bandumula, 2018). Rice is derived from the rice plant, which is then processed into rice and cooked as a staple food. Indonesia ranks as the world's third-largest consumer of rice, consuming 37,400 metric tons. Approximately 77% of farmers in Indonesia cultivate rice, making it the fourth most populous country in the world, where rice is the most important food crop (Berty, 2022).

In the daily lives of humans, food is a necessity. Food is a substance highly needed by the body and is a vital element for human life (Graham et al, 2001). The primary functions of food are as an energy source and for building new body tissues. Therefore, humans must be selective regarding food safety. Food safety must be ensured to avoid various diseases that can result from consumed food. Healthy food should not contain prohibited chemical substances in the form of Food Additives, or pathogenic microorganisms (Suparyanto and Rosad, 2020).

Rice is highly essential in daily life, which has led producers and traders in the modern era to employ various methods to increase market value and attract consumers (Barker et al, 2014). One of the methods used is adding Food Additives (BTP). Food Additives (BTP) can be chemical substances, but in reality, the chemicals used often come from hazardous chemicals, usually in the form of bleach (chlorine) (Aminah et al., 2019).

According to the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 32/Permentan/OT.140/3/2007, which states chlorine and its compounds as hazardous chemicals prohibited from use in rice milling, hulling, and rice polishing processes. However, when looking at the Regulation of the Minister of Health No. 33 of 2012 concerning Food Additives (BTP), it states that chlorine is not included as a Food Additive in the bleach and flour maturation group (Raharjo et al., 2022).

Scientifically, chlorine is a chemical that functions as a disinfectant or germicide. This chemical is toxic to the body, symbolized by a skull image. Chlorine is used in rice to achieve a white, glossy appearance and to prevent fungal growth by mixing it with rice through soaking or spraying processes. The Food and Drug Administration (FDA) sets the chlorine levels in food not to exceed 0.82 grams of sodium hypochlorite or 0.36 grams of calcium hypochlorite per 100 grams of food (Blessington et al, 2013). Therefore, chlorine is commonly used for whitening fabrics. Ingesting chlorine can cause pain and inflammation in the mouth, throat, stomach, and intestines, as well as irritation of the mucous membranes of the stomach and respiratory system. In the long term, it can lead to liver and kidney cancer (Aminah et al., 2019).

In gas form, chlorine can cause stinging eyes, dizziness, and nausea. Poisoning cases involving chlorine were reported on Monday, September 30, 2019, involving 17 residents of Sirnagalih Village, Cilaku District, Cianjur Regency. Similar incidents occurred with 33 residents in Karawang Regency, West Java, on September 14, 2022 (Maulana, 2022).

Excessive liquid chlorine also results in harmful effects. There was an incident at an elementary school in Russia, which caused 21 children to experience respiratory problems, eye pain, and irritation after swimming in a pool with excessive chlorine (Rahmawati, 2020).

Based on research (Silalahi, 2018), chlorine content is still found in rice available in the market. In the study, 16 rice samples were tested, and the results showed that 10 samples contained chlorine with levels ranging from 20 ppm to 90 ppm. Chlorine was also found in rice in traditional markets in Makassar, where 8 out of 17 rice samples

were positive for chlorine. Supporting research findings were also found at the Tanjung Market in Jember Regency, where 5 out of 17 rice samples were positive for chlorine (Suparyanto and Rosad, 2020).

According to research conducted on rats by adding chlorine to food at levels exceeding 0.82 grams of sodium hypochlorite or 0.36 grams of calcium hypochlorite per 100 grams, it would destroy the intestines in the stomach, making the stomach vulnerable to gastritis. In the long term, chlorine can lead to heart and kidney cancer (Umar, 2019).

Rice sold in markets is packaged in various forms, including bulk sales and sales based on the quantity requested by buyers. Based on observations made by the researcher, rice sales are predominantly in bulk form, matching the quantities requested by buyers (Sendeku, 2005). Given the above explanation that chlorine is highly dangerous to humans, especially in rice, the author is interested in the title "Identification of Chlorine (Cl_2) in Bulk Rice Sold in North Surabaya Region."

2 RESEARCH METHODS

This research is of a descriptive nature with the aim of determining the presence of chlorine (Cl2) content in bulk rice sold in the Pogot Market area of North Surabaya. Additionally, it seeks to describe the levels of chlorine (Cl2) in bulk rice to ascertain whether they comply with the Food and Drug Administration (FDA) regulations, which stipulate that chlorine levels in food should not exceed 0.82 grams of sodium hypochlorite or 0.36 grams of calcium hypochlorite per 100 grams of food. The study samples consist of the entire population, which includes 19 varieties of bulk rice from six different bulk rice sellers in the Pogot Market area of North Surabaya. The study involves two repetitions (this is related to the principle that increasing the number of treatment repetitions results in more precise experimental outcomes).

The sampling technique employed is systematic, initiated with an initial random selection process. Subsequently, various types of bulk rice from six different sellers in the Pogot Market, North Surabaya, are chosen. The variable in this study is the presence of chlorine content in bulk rice sold at the Pogot Market, North Surabaya. Data on the examination of chlorine compounds (Cl2) in rice are collected systematically.

The verification of chlorine content is conducted by selecting various types of bulk rice from six different sellers at the Pogot Market, North Surabaya. These rice samples are then subjected to testing in the Chemistry Laboratory of Muhammadiyah University in Surabaya using a color reaction test on the filtrate of bulk rice. The presence of chlorine (Cl2) chemical content can be confirmed through testing using the Iodometric method.

The examination for the presence of chlorine involves a color change reaction test on the filtrate. It is considered positive if the filtrate from bulk rice is mixed with 2 grams of Potassium Iodide and 10 ml of acetic acid, and titrated with Sodium

Thiosulfate solution until it turns yellow. Subsequently, amylum indicator is added until it turns blue, and the titration is continued until the blue color disappears.

3 RESULTS AND DISCUSSION

This research was conducted one day prior to the sample collection. The researcher obtained consent and conducted interviews with the rice sellers at the Pogot Market in North Surabaya. The research samples consist of bulk rice sold at the Traditional Pogot Market in North Surabaya. After examining 19 bulk rice samples with two repetitions in the Health Chemistry Laboratory of Muhammadiyah University in Surabaya on the specified date, the following results were obtained:

Table 1. Laboratory Examination Results for the Identification of Chlorine (Cl2) in Bulk Rice Sold at the Traditional Pogot Market in North Surabaya.

No	Sample Code	Rate (g/l)	Information (M)/(DM)
1	A1	0,00	M
2	A2	0,08	DM
3	A3	0,00	M
4	A4	0,00	M
5	A5	0,00	M
6	A6	0,00	M
7	A7	0,00	M
8	A8	0,00	M
9	A9	0,00	M
10	A10	0,00	M
11	A11	0,00	M
12	A12	0,00	M
13	A13	0,00	M
14	A14	0,00	M
15	A15	0,10	DM
16	A16	0,00	M
17	A17	0,06	DM
18	A18	0,00	M
19	A19	0,00	M

Information :
M = Meet <0,82 gram (FDA)
DM = >0,82 gram (FDA)

From the examination results of chlorine in bulk rice sold in the Pogot Market area of North Surabaya, it is known that 3 samples are positive (+) and their levels do not meet the Food and Drug Administration (FDA) standards, while 16 samples are negative (-) and comply with the FDA standards.

Table 2. Percentage of Chlorine (Cl2) Levels in Bulk Rice with FDA Compliance is presented in the following table:

No	Observation Result	Amount	Percentage (%)
1	Meet	16	84,21 %
2	Do not Meet	3	15,79 %
	Total	19	

From the table above, it is evident that the number of bulk rice samples that tested positive and did not comply with FDA standards (containing chlorine) is 3 samples, and there are 16 negative samples sold in the Pogot Market, North Surabaya. It is also presented in the form of a pie chart as shown in the image below.

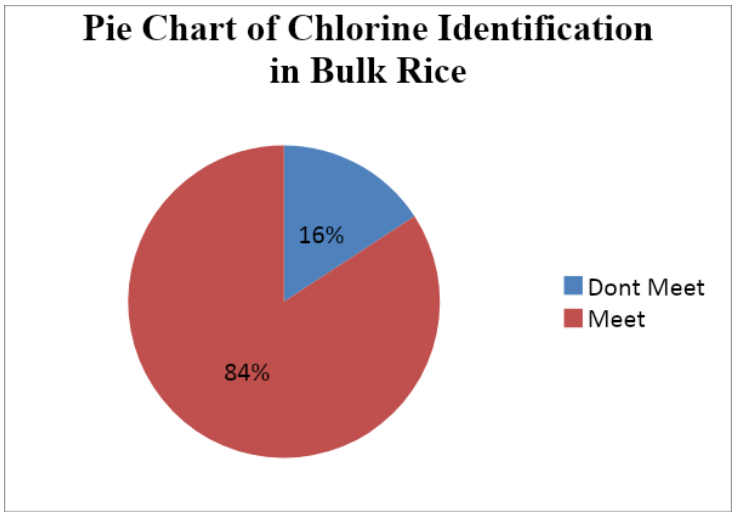

Fig. 1. Pie Chart of Chlorine (Cl2) Content Percentage in Bulk Rice Sold in the Pogot Market Area, North Surabaya.

The laboratory examination results for bulk rice sold in the Pogot Market area of North Surabaya indicate that 3 samples (15.79%) out of the total samples are positive or contain chlorine. Based on the conducted test, the positive samples contain chlorine, which is indicated by the formation of yellow color due to chlorine's strong oxidizing properties, which will reduce excess potassium iodide and produce iodine. The reaction

that occurs is $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$. The resulting iodine is then titrated with a standard solution of sodium thiosulfate, and the volume of thiosulfate used is directly proportional to the iodine produced, with the reaction $I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^-$ (Verma et al, 2011).

Rice plays a vital role in daily life as a staple food. Rice is undoubtedly the primary choice of consumers (Ohnuky, 1994). Therefore, many rice producers compete to enhance the attractiveness of their products to consumers. One way is by adding bleaching agents to rice to make it appear more appealing. The bleaching agents used are usually hazardous chemicals, such as chlorine, which are harmful and dangerous to consumers (Sudarma, Idayani, and Setiawan, 2018).

Chlorine is a chemical that is often used as a disinfectant. In its gaseous form, chlorine has a strong odor. Ingesting chlorine can cause pain and inflammation in the mouth, throat, stomach, and intestines, as well as irritation of the mucous membranes of the stomach and respiratory system. Chlorine added to rice can erode the mucous membrane of the stomach (corrosive), making it susceptible to gastric diseases. In the long term, consuming rice containing chlorine can lead to liver and kidney cancer (Asrina and Anganria, 2019). Chlorine is an element found on Earth and is rarely encountered in its free form. Typically, chlorine is found in combination with other elements or compounds. Chloride, on the other hand, is a compound formed from chlorine.

Chlorine is often found in combination with other elements or compounds, forming sodium hypochlorite ($NaClO_2$), also known as sodium hypochlorite. Additionally, chlorine that is bonded can also form calcium hypochlorite ($Ca(ClO)_2$), which serves as a cleaning agent (Kurniastiti, 2012).

The use of chlorine as a bleaching agent in bulk rice aims to make the rice appear more attractive, shiny, and white (Srilakshmi, 2003). This benefits producers because consumers are more inclined to buy such rice. With high consumer interest, producers naturally earn more profits. However, it's important to note that chlorine as a bleaching agent is very harmful to health.

From the laboratory examination results for bulk rice sold in the Pogot Market area of North Surabaya, it is evident that 16 rice samples, accounting for 84.21%, tested negative. The use of Food Additives (BTP) is regulated under the Minister of Health Regulation number 722/Menkes/Per/IX/88 concerning Food Additives. The additives often added to rice are hazardous, and chlorine is one of the commonly used additives. According to the regulation, chlorine is not categorized as a Food Additive (BTP) in the bleaching and maturation of flour group (Minister of Health Regulation). Therefore, the use of chlorine as a Food Additive (BTP) should be avoided because it can have adverse effects on human health when consumed (Ibrahim et al, 2021). The effects of consuming the harmful substance chlorine can manifest over a long period. Hence, it is hoped that producers can replace chlorine with safer alternatives as bleaching agents, and consumers can be more cautious in selecting rice as a raw food material.

4 CONCLUSION AND RECOMMENDATION

Based on the research results of chlorine identification in bulk rice sold in the Pogot Market area of North Surabaya, it can be concluded that 3 rice samples, accounting for 15.79%, do not comply with the Food and Drug Administration (FDA) standards, while 16 samples, accounting for 84.21%, are declared to be chlorine-free.

5 REFERENCES

Asrina, R. and Anganria, J. (2019). Analisis Kualitatif Klorin (CL2) Pada Beras Putih Yang Beredar Di Pasar Tradisional Daya Kota Makassar. Jurnal Farmasi Sandi Karsa, 5(1), pp. 1–4. Available at: https://doi.org/10.36060/jfs.v5i1.27.

Ayu Devianti, V. and Herlina Yulianti, C. (2018). Identifikasi dan Penetapan Kadar Klorin Dalam Pembalut Wanita yang Beredar di Kelurahan Ketintang dengan Metode Titrasi Iodimetri. Journal of Pharmacy and Science, 3(1), pp. 9–12.

Barker, R., Herdt, R. W., & Rose, B. (2014). *The rice economy of Asia*. Routledge.

Bandumula, Nirmala. (2018). Rice production in Asia: Key to global food security." *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences* 88: 1323-1328.

Blessington, T., Theofel, C. G., Mitcham, E. J., & Harris, L. J. (2013). Survival of foodborne pathogens on inshell walnuts. *International journal of food microbiology*, *166*(3), 341-348.

Berty, T. (2022). 5 Negara Paling Banyak Konsumsi Nasi.

Citra, A. (2021) Kenali Gejala, Cara Mengatasi, Plus Trik Mencegah Keracunan Klorin., hellosehat. Available at: https://hellosehat.com/.

Damayati, D.S. and Satriani. (2014). Pengaruh Kandungan Klorin pada Air Teh Celup Berdasarkan Waktu dan Metode Pencelupan di Kota Makassar Tahun 2014', Al - Sihah : Public Health Science Journal, pp. 41–49.

David, J.H. and Kartinaty, T. (2019). Karakteristik Mutu Beras Di Berbagai Penggilingan Pada Sentra Padi Di Kalimantan Barat. Journal TABARO Agriculture Science, 3(1), p. 276. Available at: https://doi.org/10.35914/tabaro.v3i1.197.

Dr. Ir. Edy, M.P., M.P. (2022). Pengantar Teknologi Budidaya Tanaman Serealia. Edited by P. Susapti. Yogyakarta. Available at: PT. Nas Media Indonesia Anggota IKAPI.

Faisal, A. (2022) Kenali 5 Jenis Beras Putih di Indonesia. Manakah yang sering Kalian Konsumsi?, GoodNews.

Fitriyah, D., Ubaidillah, M. and Oktaviani, F. (2020). Analisis Kandungan Gizi Beras dari Beberapa Galur Padi Transgenik Pac Nagdong/Ir36', ARTERI : Jurnal Ilmu Kesehatan, 1(2), pp. 153–159. Available at: https://doi.org/10.37148/arteri.v1i2.51.

Fortuna, Dewi (2022). Tinjauan Kriminologi Terhadap Tindak Pidana Produsen Yang Menggunakan Bahan Tambahan Pangan Yang Dilarang.

Graham, Robin D., Ross M. Welch, and Howarth E. Bouis. (2001). Addressing micronutrient malnutrition through enhancing the nutritional quality of staple foods: principles, perspectives and knowledge gaps: 77-142.

Hasan, A. (2006). Dampak penggunaan klorin. J. Tek. Lingk. P3TL-BPPT, 7(1), pp. 90–96.

Hasanah, L.N., Rosnah, R. and Kendari, P.K. (2022). Keamanan dan Ketahanan Pangan.

Hasanah, U. (2018). Makalah Ilmu Bahan Makanan Lanjut Btp Pemutih Dan Pematang Tepung. Politeknik Negeri Jember [Preprint].

Ibrahim, A. O., Adegoke, K. A., Adegoke, R. O., AbdulWahab, Y. A., Oyelami, V. B., & Adesina, M. O. (2021). Adsorptive removal of different pollutants using metal-organic framework adsorbents. Journal of Molecular Liquids, 333, 115593.

ICSA, (2022). Perbedaan Klorin dan Kaporit : Fungsi, Sifat, dan Dampaknya untuk Air Minum dan Kolam Renang, PT.ICSA.

Kemas Ali Hanafiah (2010). Rancangan percobaan dan Teori & aplikasi. Rajawali Press, p. 29.

Kurniastiti, S. (2012). Pabrik Sodium Hipoklorit Dari Air Laut Dengan Proses Elektrolisa.

Laila Desy Nur Fitriya. (2015). Analisa Kadar Klorin Pada Bubur Ayam Yang Dijual Di Sepanjang Jl. Kenjeran Surabay. titutional environment and entrepreneurial cognitions: A comparative business systems perspective. Entrepreneurship theory and Practice., (564), pp. 1–73.

Masbim (2022) Mengenal Rasa dan Jenis Berbagai Beras Lokal, Jagadtani.

Mohidem, N.A., Hashim, N., Shamsudin, R., Che Man, H. (2022) Rice for Food Security: Revisiting Its Production, Diversity, Rice Milling Process and Nutrient Content. *Agriculture*, *12*, 741. https://doi.org/10.3390/agriculture12060741

Maulana, I. (2022). Puluhan Warga Karawang Dibawa ke RS gegara Keracunan Gas. Available at: https://www.detik.com.

Nur, W. and Fiqih, E.L. (2017). Nonsubsidi.

Oktaviani, N., Utami, M. and Kasasiah, A. (2022). Identifikasi Rhodamin B dalam Lipstik yang Beredar di Pasar Baru Kota Bekasi Nadia Oktaviani. Tunas-Tunas Riset Kesehatan, 12(1), pp. 281–285.

Ohnuki-Tierney, E. (1994). Rice as self: Japanese identities through time. Princeton University Press.

Permendag. (2014). Available at: file:///C:/Users/smart hp/Documents/SEMESTER 2/PMI/NASI MAKALAH/Permendag No. 19 Tahun 2014.pdf.

Permenke. (1985). Peraturan Menteri Kesehatan Republik Indonesia Nomor : 722/MENKES/PER/IX/88', 21(4), p. 162.

Pratiwi Hermiyanti. (2016). Pengaruh Paparan Klorin Di Udara Terhadap Peroksidasi Lipid Pada Pekerja Kolam Renang. Jurnal penelitian kesehatan suara forikes, VII(2), pp. 85–88.

Raharja, S. et al. (2020). Pengolahan Beras Dan Produksi Beras-Gluten (Beras-Ten). Cetakan 1. Bogor: PT Penerbit IPB Press.

Raharjo, P. et al. (2022). Media Kesmas (Public Health Media) Analisa Klorin Pada Beras Yang Beredar Di Pasar Tradisional Cik Puan Kota Pekanbaru Tahun 2020 Chlorine Analysis in Rice Circulating in The Cik Puan Traditional Market , Pekanbaru , 2020', 2, pp. 94–101.

Rahmawati, Y. (2020) Terlalu Banyak Klorin di Kolam Renang, 30 Orang Keracunan. Available at: https://www.suara.com.

Reichenbach, A. et al. (2019). Dinamika Kebijakan Impor Beras Era Pemerintahan Presiden Joko Widodo Di Indonesia. Progress in Retinal and Eye Research, 561(3), pp. S2–S3.

Restu, T., Hariyani, N. and Handarini, K. (2009). Analisis Keamanan Pangan Pada Beras Kajian Dari Kandungan Klorin.

Sendeku, W. (2005). Factors determining supply of rice: A study in Fogera district of Ethiopia. *An M. Sc Thesis Presented to the School of Graduate Studies of Hararnay University*.

Sofyan, D.K. (2018). Planning and Poduction System Peramalan Kebutuhan Klorin (Cl2) Pada Bagian Produksi Di PT Pupuk Iskandar Muda. Industrial Engineering Journal, 7(1), pp. 30–35.

Srilakshmi, B. (2003). *Food science*. New Age International.

Sudarma, N., Idayani, S. and Setiawan, D. (2018). Klorin Pada Beras Berpemutih Utilization Of Betadine As A Chlorine Test, 5(2), pp. 157–164.

Sukmawati, Nurdiyanah and Azriful (2016). Gambaran Kadar Klorin (Cl2) Pada Beras Di Pasar Toddopuli Kecamatan Panakkukang Kota Makassar, 2(2).

Suparyanto dan Rosad (2015). Analisis Senyawa Klorin (Cl2) Pada Beras yang Dijual Di Pasar Sokaraja Kabupaten Banyumas Olivia, 5(3), pp. 248–253.

Ulfa, A.M. (2015). Metode Iodometri. E- Journal, 9(4), pp. 197–200.

Umar, U.T. (2019). The 1 International Conference on Public Health Universitas Teuku Umar, 18 November 2019, (November), pp. 195–199.

Verma, N. K., Vermani, B. K., Verma, N., & Rehani, K. K. (2011). Comprehensive Practical Chemistry XII. Laxmi publications.

Wibisono, I.S. and Mujiyono, S. (2018). Segmentasi Fuzzy C-Means Untuk Membantu Identifikasi Kualitas Beras Berdasarkan Nilai Threshold , Warna Dan Ukuran. Multimatrix, I(1), pp. 22–25.