



Relationship Between The Presence Of Bromide Ion In The Blood And Disturbance Of Body Balance In The Fumigator At Tanjung Emas Port, Semarang

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Abstract

Tanjung Emas Port Semarang is one of the ports that organizes fumigation activities. Fumigation measures in the context of controlling pests or insects on conveyances and container loads are at risk of exposure to methyl bromide fumigants which can cause poisoning to disturb the body balance. The purpose of this study was to determine the relationship between the presence of bromide ions in the blood and disturbances of body balance in the fumigator.

This study was an observational study with a cross

sectional study design. The number of samples was 38 fumigators with the criteria of being willing to be respondents aged 19-55 years with the sampling technique method with saturated samples. The method of examining bromide ions in the blood is through a qualitative inorganic analysis test, while the method of measuring body balance disorders uses the Romberg test method (sharpened).

The results of data analysis showed that laboratory tests of the bromide ion in the fumigator blood were positive for 22 people or 57.9%. The compliance factor for wearing Personal Protective Equipment and the frequency of fumigation were not related to the presence of bromide ions in the fumigator blood. Measurement of body balance disorders showed positive 26 people or 68.4% and 12 people or 31.6% negative. Analysis of the variables of the presence of bromide ions in the blood with disturbed body balance in the fumigator using the Chi Square test (X²) obtained a p value of 0.002 less than α (0.05).

There is a relationship between the presence of bromide ions in the blood and disturbances in body balance in the fumigator at Tanjung Emas Port, Semarang.

Keywords: Methyl bromide, fumigation, body balance disorders

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INTRODUCTION

Tanjung Emas Port Semarang is the largest port in Central Java. The Tanjung Emas Port Semarang area consists of 2 parts, namely the perimeter and the buffer which are the working area of the Semarang Port Health Office in the supervision of vector control activities. The perimeter area is an inner port area that is bounded by a port boundary fence while the buffer area is a land area with a radius of 2 (two) kilometers outside the perimeter area. other nuisance animals (Permenkes RI, 2013).

The fumigation action at Tanjung Emas Port Semarang in 2 ways, namely using a manual system which is generally used in ship space fumigation which requires a relatively large space and the evaporation system is generally used for container room fumigation. (Niberisa, 2012) Methyl bromide is a chemical compound in a liquid gas dosage form, colorless, non-flammable, and packaged in a blue iron tube. The main choice of fumigation using methyl bromide because this substance has a deadly effect or killing power against insect pests on the conveyance and cargo because of its strong penetration properties and does not cause a fire hazard. (Pertanian BK, 2015)

Acute exposure to methyl bromide in humans can cause health problems such as nausea, dizziness, skin irritation, and death. Chronic exposure through indirect absorption on the skin can cause damage to brain cells and the human nervous system. (Government, 2015)

Risk factors due to exposure to methyl bromide fumigants can have a negative impact on health if it enters the body through the skin, inhalation and ingestion with concentrations above 120 ppm will have an impact on nervous system damage. This is often not seen physically but can be seen in difficulty focusing the eyes and speech problems. This factor in the presence of bromide ions in the blood can disrupt the body's balance in the fumigator. (Government, 2015)

The results of the 2018 research conducted by Susanto N (study area at the Semarang Class II Port Health Office) on 45 ship fumigators in fumigation action for examining bromide ions in blood serum, there were 37 people with positive results of 37 people (84.4%) and negative 8 people (15.6%) (Nugroho, 2018) This indicates that the level of exposure to methyl bromide that enters the body of the fumigator with a positive result is high enough that it can cause poisoning and can even cause disruption of the body's balance at a certain time.

This study aims to determine the relationship between the presence of bromide ions in the blood and the disturbance of body balance in the fumigator at Tanjung Emas Port Semarang and the factors in fumigation with the presence of bromide ions in the body of the fumigator, such as compliance with personal protective equipment and frequency of fumigation.



MATERIALS AND METHODS

The method of data collection in this research is observational research, where the data is collected by conducting field observations with a cross sectional design. The population of this research is 38 fumigators who work in private business entities that have vector control permits in the Tanjung Emas Port area of Semarang. The sampling technique was saturated, namely taking the sample as a whole with the aim that all members of the population were used as samples, namely 38 people. The inclusion criteria of respondents who were sampled were aged 19 - 55 years, present at the time of the study, willing to become respondents and work to apply methyl bromide for 14 days after fumigation. Examination of bromide ions in the blood was carried out using qualitative inorganic analysis methods (Vogel, 1979), while to determine the presence of body balance disorders in the fumigator using the romberg test was sharpened based on the diagnosis of medical personnel from the Semarang Port Health Office by instructing respondents to stand upright on a flat floor surface. Without using footwear and opening the eyes with the feet positioned because the respondent is asked to stand with the heel of the non-dominant foot in front of the other leg with the hands folded in front of the chest for 1 minute (Johnson, Wright, Beazley, 2005)

The method of collecting primary data which includes checking for bromide ion variables, disturbance of body balance, compliance with personal protective equipment and frequency of fumigation is done through observation and field interviews. Data processing was performed using SPSS software with several steps, namely editing, coding, data entry and tabulating. Statistical analysis of data was carried out by univariate and bivariate methods. In the bivariate analysis using Chi Square (X^2) with a confidence degree of 95% (the limit of significance used was $p < 0.005$).

This research has received information that has passed an ethical review from the Health Research Ethics Commission, Faculty of Public Health, Diponegoro University No: 596 / EA / KEPK-FKM / 2020 on January 23, 2020.

RESULTS AND DISCUSSION

Field observations were carried out at the fumigation depot on the Deli Tanjung Emas Port Semarang street from 17 February to 11 March 2020 of 38 fumigators from 8 private business entities in the Tanjung Emas Port Semarang. The table of fumigator characteristics can be seen in table 1 and table 2.



Table 1 Characteristics of fumigators at the Port of Tanjung Emas in Semarang in 2020

No	Variable	n	min	maks	mean	SD
1	Respondent's age (years)	38	22	55	34	7,94
2	Length of work (years)	38	0,5	20	6	5,17

The results in table 1 show that the characteristics of the respondents indicate that the youngest age is 22 years and the oldest is 55 years with an average age of the fumigator is 34 years. Respondents who worked as a fumigator for the longest 20 years while the minimum was 6 months with the average respondent working as a fumigator being 6 years.

Table 2 Distribution of fumigator characteristics by category at Tanjung Emas Port Semarang in 2020

No	Variable	Frequency	%
1	Gender		
	Male	37	97,4
	Woman	1	2,6
2	Education		
	Junior high school	6	15,8
	Senior High School	27	71
	Diploma / Bachelor degree	5	13,1
3	Drugs consumed by the fumigator		
	Never	45	100
4	Diseases suffered by fumigators		
	There is no	45	100
5	Consume alcohol-containing drinks		
	Sometimes	1	2,6
	Never	37	97,4
6	Eat foods that are suspected to contain bromide		
	Never	45	100
7	Compliance with wearing Personal Protective Equipment		
	Not obey	24	63,2
	obey	14	36,8
8	Fumigation frequency		
	Often	22	57,9
	Sometimes / rarely	16	42,1



The results in table 2 show that the average sex of the fumigator was dominated by men as many as 37 people or 97.4% and women only 1 person or 2.6%. Most of the educational backgrounds of fumigators are Senior High School as many as 27 people or 71%, Junior High School as many as 6 people or 15.8% and Diploma or Bachelor Degree as many as 5 people or 13.1%. There are no fumigators who are currently on drug therapy for health, consuming foods containing bromide ions and suffering from a history of certain diseases related to the respiratory tract such as asthma, coughing and lungs but there is 1 person (2.6%) who consumes alcoholic drinks with frequency sometimes 1-2 months and 37 people or 97.4% never consumed alcohol.

The results of this study were several factors in fumigation measures that were analyzed by the presence of bromide ions in the blood, including the frequency of fumigation and compliance with personal protective equipment. (Akca, 2009)

The results of the bivariate analysis of the compliance factor using Personal Protective Equipment and the frequency of fumigation in the presence of bromide ions in the blood and the presence of bromide ions in the blood with disturbed body balance in the fumigator at Tanjung Emas Port Semarang can be seen in table 3-5 below.

1. The relationship between compliance with personal protective equipment and the presence of bromide ions in the blood in the fumigator at Tanjung Emas Port, Semarang.

Table 3. Cross tabulation between compliance with personal protective equipment and the presence of bromide ions in the blood in the fumigator at Tanjung Emas Port, Semarang in 2020

Compliance with wearing Personal Protective Equipment	Keberadaan ion bromida dalam darah				Total	RP (95% CI)	p value (χ^2)
	Positive		Negative				
	n	(%)	n	(%)	n	(%)	
	Not obey	17	70,8	7	39,2	24	100
Obey	5	35,7	9	64,3	14	100	0,939-4,191

There are 2 categories of compliance in using Personal Protective Equipment on the fumigator, namely disobedience and obedience. Respondents who did not comply with personal protective equipment were 24 people, 17 people or 70.8% positive fumigators contained bromide ions in the blood and 7 people or 39.2% fumigators did not contain bromide ions in their blood. Meanwhile, 14 people obedient to wear personal protective equipment, 5 people or 35.7% positive fumigators contained bromide ions in the blood and 9 people or 64.3% fumigators did



not contain bromide ions in their blood. After the bivariate analysis was carried out using the chi-square test, it was found that the p value was 0.076 which was greater than α (0.05), so there was no relationship between compliance with personal protective equipment and the presence of bromide ions in the blood in the fumigator. This is possible during interviews and field observations, most of the respondents in implementing compliance with wearing personal protective equipment, especially types of personal protective equipment such as work clothes (wearpacks) as many as 30 people (79%), respiratory protection equipment 35 people (92%), shoes booted 28 people (73.6%). In addition, the results of interviews in the field of cleanliness and storage conditions for Personal Protective Equipment were always cleaned every day after the fumigation action of 28 people or 73.6% and placed in a special room for storing Personal Protective Equipment but still found that most of the fumigators were not yet compliant in using this type of equipment. Personal protection such as gloves of 20 people (52.7%), helmets of 32 people (84.2%) and medical warning signs of 38 people (100%). The results of observations when in the field of suitability for the use of Personal Protective Equipment in the form of work clothes that were in accordance with the standard were 38 people or 100% and respiratory protection equipment as many as 37 people or 97.4% who met the standard requirements of the Agricultural Quarantine Agency. The knowledge of fumigators about fumigation techniques and types of personal protective equipment was mostly understood by the respondents as many as 28 people or 73% and all fumigators always maintain personal hygiene by taking a shower after the fumigation action is carried out. The condition of the fumigator age, which is 34 years, allows the body to be stable and well maintained, this can be seen from the results of field interviews which show that 38 respondents (100%) do not have a history of certain diseases related to respiratory diseases. The conditions in the field showed that 17 people (70.8%) still had positive fumigators containing methyl bromide in their blood because they did not regularly use personal protective equipment for 15-30 minutes such as helmets, gloves, and sometimes masks because the condition of the fumigator who feels uncomfortable in carrying out fumigation activities when using Personal Protective Equipment continuously for 2 hours when aeration / liberation of methyl bromide gas in the room. Methyl bromide fumigant is a type of insecticide that has almost the same properties and characteristics as the organophosphate or organochlorine pesticides, both in terms of the pathway of entering the body through inhalation, ingestion and skin to the effects on health, namely nausea, dizziness, skin irritation and can even damage the nervous system. center. (Romah, Ghaisani and Mayasari, 2019)

The results of this study are in line with Minaka's research in 2016 which states that there is no relationship between the use of personal protective equipment (hats, work clothes, trousers, boots) and health complaints (in the form of headaches, fatigue, nausea and itching) among



horticultural farmers in Buleleng. Bali. (Minaka, Astuti, Sawitri and Wirawan, 2016) BJ Azmi's research in 2019 states that there is no relationship between the use of personal protective equipment (work clothes, masks, gloves and boots) and health complaints against farmers in Pringgondani Village, Sumberjambe District, Jember Regency. (As'ady, Azmy, Supangkat and Indreswari, 2019) The conclusion of this study is not in line with Susanto N's research in 2018 which states that there is a relationship between compliance with personal protective equipment and the presence of bromide ions in fumigator blood at Tanjung Emas Port Semarang. The difference in the conclusion of this study is possible because in this study, it was found that 36 respondents (100%) who were not adherent positively contained bromide ions in the blood, besides that there were fumigators that leaked during methyl bromide fumigation as many as 38 people (84.4%) and places. different sample examination laboratories. Other studies that are less in line with the State of Turkey in 2009 regarding methyl bromide exposure stated that adherence to wearing personal protective equipment was significantly associated with the increase in bromide ions in plantation workers.

2. The relationship between the frequency of fumigation and the presence of bromide ions in the blood in the fumigator at Tanjung Emas Port, Semarang.

Table 4. Cross tabulation between the frequency of fumigation and the presence of bromide ions in the blood in the fumigator at Tanjung Emas Port, Semarang in 2020

Fumigation frequency	The presence of bromide ions in the blood				Total		RP (95% CI)	p value (χ^2)
	Positive		Negative					
	n	(%)	n	(%)	n	(%)		
Often	15	68,2	7	31,8	22	100	1,558	0,241
Sometimes	7	43,8	9	56,2	16	100	0,834-2,911	

There are 2 categories of fumigation frequency in the fumigator in the field, namely frequent and occasional. Respondents with frequent frequency were 22 people, 15 people or 68.2% positive fumigators contained bromide ions in the blood and 7 people or 31.8% fumigators did not contain bromide ions in their blood. Meanwhile, the frequency of fumigators is sometimes 16 people, 7 people or 43.8% positive fumigators contain bromide ions in the blood and 9 people or 56.2% fumigators do not contain bromide ions in their blood. After the bivariate analysis was carried out using the chi-square test, the p value obtained was 0.241 greater than α (0.05), so there was no relationship between the frequency of fumigation and the presence of bromide ions in the blood in the fumigator. This was due to the fact that at the time of the interview in the field, the knowledge of fumigators about fumigation techniques and types of personal protective equipment for fumigation was mostly understood by 28 people or 73% of the respondents, besides that most of the fumigators were able to maintain personal hygiene by



taking a shower after the fumigation action was carried out. The physical condition of the fumigator is relatively well preserved because the diet and adequate rest in the work system in carrying out fumigation actions is less than 8 hours a day according to the guidelines of the Agricultural Quarantine Agency even though the frequency of fumigation at the fumigation depot location jl deli, Tanjung Emas Semarang Port is carried out 1-2 days once. The results of the study still found that most of the fumigators were positive for methyl bromide in the blood as many as 22 people or 57.9%, because during fumigation in the field most of the fumigators did not fully understand the dangers posed by methyl bromide fumigants during fumigation, especially during the process. aeration or liberation of methyl bromide gas into the air allowing fumigants to enter the body without being noticed by the fumigator in the field.

This research is in line with Nugroho S's research in 2018 which states that there is no relationship between the frequency of fumigation and the presence of bromide ions in the blood of fumigators at the Port of Tanjung Emas Semarang. This conclusion is not in line with Sumayah Annida's research in 2018 which states that there is a relationship between the frequency of spraying and pesticide poisoning in farmers in Srikaton Village, Adiluwih District, Pringsewu Regency (Annida, 2018). This difference in conclusion is due to the frequency of pesticide spraying that is done more than 2 times a week with a duration of spraying pesticides for 5 hours (06.00.11.00).

Zulmi N's research in 2016 in Boyolali in his research also concluded that there was a strong relationship between the frequency of spraying and a decrease in the activity of the cholinesterase enzyme in the blood of farmers in the yellow flower village, Cepogo District, Boyolali Regency (Zulmi, 2016), but this research was in line with what was done on workers. in 2009 which stated that plantation farmers in Turkey obtained data on the frequency of fumigation factors not associated with an increase in bromide ion levels in the blood of these agricultural workers.

3. The relationship between the presence of bromide ions in the blood and disturbances in body balance in the fumigator at the Port of Tanjung Emas, Semarang.

Table 5. The results of the bivariate analysis between the presence of bromide ions and disturbances in the balance of the body in the blood of fumigators at the Tanjung Emas Port Semarang in 2020

The presence of the bromide ion	Impaired body balance				Total		RP (95% CI)	p value (χ^2)
	Positive		Negative					
	n	(%)	n	(%)	n	(%)		
Positive	20	90,9	2	9,1	22	100	2,424	
Negative	6	37,5	10	62,5	16	100	1,270- 4,626	0,002



Based on the data in table 5, it shows that out of a total of 22 respondents, the results of positive laboratory tests containing bromide ions in the blood were 20 people or 90.9% had disturbances in body balance, while of the 16 respondents with positive laboratory test results containing bromide ions in the blood 6 people or 37.5% positive for impaired balance of the body (Romberg test sharpened).

Based on the chi square statistical test, it was obtained that the p value = 0.002 was smaller than α (0.05) so that H_0 was rejected. The conclusion is that there is a relationship between the presence of bromide ions in the blood and disturbances in body balance. The results of data analysis $RP = 2,424$ with 95% Confidence Interval (CI) = 1,270-4,626. The value of $RP = 2.424$ indicates that people whose blood contains bromide ions have a nearly 2.5 greater risk of experiencing a disturbance in body balance compared to fumigators that do not contain bromide ions in their blood. This means that the presence of bromide ions in the blood is a risk factor for disturbing the body's balance.

The test results in table 5 show that a fumigator with a positive result containing bromide ions in the blood has a nearly 2.5 times risk of disturbing the body's balance compared to a fumigator that is negative or does not contain bromide ions in the blood. This is because at the time of the interview most of the respondents did not understand the health hazards of exposure to methyl bromide which enters the body through inhalation or the skin during fumigation. This is based on the fact that when interviewing in the field, most of the fumigators in answering the questions did not fully understand the dangers posed by these fumigants. In addition, the respondent's habit of taking lightly or the usual things about complaints that have been felt, especially during the aeration process or the release of methyl bromide gas, such as nausea and dizziness because they are part of work risks.

The mechanism of bromide ions enters the body through ingestion, inhalation and the skin is distributed to the blood and body tissues including the lungs, kidneys and brain through the circulatory system but some bromide ions are immediately eliminated through the body's fluid excretion system, namely the respiratory tract, sweat and urine (Endrinaldi, 2010). The bromide ion is distributed into the blood through the hydroxylation process by the enzyme monohydrogenase to produce metabolites that are more polar and water-soluble. These metabolites react with the glutathione enzyme to bind the bromide ions that enter the body by forming the enzyme glutathione cojugate, because the bromide ions that enter the body are considered foreign substances. The metabolite form of bromide glutathione s cojugate in the body has a half-life of about 12 to 14 days after exposure and is then excreted from the body through urine metabolism. (Government, 2015) The normal limit of bromide ions in the body is $<1\text{mg} / 100 \text{ ml}$, if the bromide level exceeds the body's limits, then There will be toxic effects of



exposure to bromide ions in the body, but it has been reported that high doses of oral cytein can reduce the result of methyl bromide poisoning because of its function to bind bromide ions in the blood. (Setiawan, Amantoro, Noerahman, 2006) In line with a study in Germany in 2011 on the case of factory workers who handled fumigation of exported and imported agricultural products, fumigators were at risk of being exposed to methyl bromide in their blood. (Preisser, Budnik, Hampel, 2011)

Examination of body balance disorders using the Sharpened Romberg test method found that 26 people or 68.4% of positive fumigators had disturbed body balance and 12 people or 31.6% of them did not experience disturbances in body balance. This is because at the time of the interview in the field most of the fumigators did not understand about the dangers due to exposure to methyl bromide to health problems in the body with work experience mostly found to be <5 years old as many as 20 people or 67% with an average age of fumigators who had disturbed body balance. is 34 years old. Fumigators must be careful in applying methyl bromide fumigants in their work during fumigation action considering the nature and characteristics of methyl bromide is very toxic to humans so it is very risky for health problems, especially damage to the nervous system. (Preisser, Budnik, hampel, 2011) Methyl bromide fumigants in general have properties and effects on health similar to other types of pesticides such as organophosphates which can interfere with the function of the central nervous system in humans. (Rohmah, Ghaisani and Mayasari, 2019) One of the chronic effects of organophosphate pesticides on the neurological system is its disruption. memory function.

Efforts that have been made in the context of increasing the capacity of fumigators in the field were held by the Semarang Agricultural Quarantine Center in 2018 through training on container fumigation actions at the fumigation depot at the Tanjung Emas Port Semarang. Medical examination for fumigators is mandatory periodically up to once a year, but with the parameters of cholinesterase examination so that the examination is not in accordance with the methyl bromide fumigant used. This requires the support of collaboration with the Health Laboratory Center in Semarang for laboratory examinations with parameters of bromide ion in blood for fumigators for the future by authorized agencies such as the Semarang Port Health Office or the Semarang Agricultural Quarantine Center.

The presence of bromide ions in the blood can interfere with the health of the body through blood circulation which can affect the function of the central nerve in the brain so that it can disrupt the balance of the body. (Beasley, 2005) Exposure to bromide ions derived from methyl bromide fumigants acutely in humans has very detrimental effects on health. , if exposed directly to the skin there will be skin irritation or blistering, if inhaled through the respiratory tract it will have the effect of nausea, vomiting, irritating the airways, and if swallowed will irritate the



respiratory tract and within a certain period of time it can also damage the nervous system even up to by causing death. (Government, 2015) In line with this study, the case in India in 2013 at a chemical compound manufacturing plant as a methyl bromide fumigant indicated a relationship between an increase in serum bromide levels in workers with the effects of methyl bromide on health which could disrupt the nervous system through the results of the examination. n Magnetic Resonance Imaging (MRI). (Souza, Aaron, Kedareshwar, 2013)

This research is in line with Kanocrat S research in Thailand in 2008 concerning the risk effects of methyl bromide poisoning with a serum bromide ion concentration of 8.18 mg / dl in a 24-year-old worker in imported vegetable and food warehouses showing symptoms of vertigo and unstable gait for 2 years. week (Suwanlaong, Phanthumchinda, 2008). Another research that is in line with Samosir K in 2017 on horticultural farmers in Ngablak District, Magelang Regency which states that there is a relationship between exposure to pesticides (organophospat) and disturbances in body balance with the Romberg test method (Samosir, Kholilah, Setiani and Nurjazuli, 2017), because the more pesticide exposure the greater the risk of experiencing interference body balance that occurs in farmers. This study is also in line with the case of methyl bromide exposure levels in 1996 in France which showed a relationship between levels of methyl bromide exposure and neurological damage to the human body (Deschamps and Turpin, 1996) but not in line with cases of exposure to methyl bromide due to leakage of fire extinguishers in France in 2002 showed that poisoning due to exposure to methyl bromide in a young woman. The initial blood level of bromide ion showed 202 mg / L, then gradually decreased to normal levels within 2 months and after one year of exposure this patient showed no signs of central nervous system toxicity. (Hoizey, 2002)

CONCLUSION

This study concluded 1) A total of 22 people or 57.9% positive fumigators contained bromide ions in the blood 2) A total of 26 people or 68.4% of the fumigators had a disturbance in body balance 3) There was no relationship between compliance with personal protective equipment ($p = 0.076$), the frequency of fumigation ($p = 0.241$) with the presence of bromide ions in the blood 4) There is a relationship between the presence of bromide ions in the blood and disturbances in body balance in the fumigator at Tanjung Emas Port Semarang with ($p = 0.002$).



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