

## A Case Study of an Investigation of Nitrate in Everyday Foods

Sirawan Boonlieng Temboonkiat<sup>1</sup>, Patnarin Choomwattana<sup>1</sup>, Virunpat Puengrotha<sup>2</sup>

<sup>1</sup>ICS International Community School, <sup>2</sup>Shrewsbury International School

### Abstract:

Unsafe food containing harmful bacteria, viruses, parasites or chemical substances cause over 200 different diseases from diarrhea to cancer. There are processed meat containing nitrate which are typically added to preserve meat, vegetables etc in the human diet, of which exceeded safe amounts.

Objective: To find nitrate and nitrite in food

Result: Of the 18 food samples tested, they consisted of 6 samples of sausage products, 6 samples of fresh vegetables, and 6 samples of drinking water to determine the nitrate content in each product. Of the sausage product samples, there were a total of 6 samples found that exceeded the nitrate content limit, representing 100% of the total number of samples. The amount detected was 700-1000 mg/kg of nitrate. Of the fresh vegetable samples, including eggplants, lentils, cucumbers, kale, cabbages, and carrots, there were a total of 6 samples out of the 6 samples found that had a nitrate content that was lower than 25 mg/kg. (0%). Of the 6 samples of drinking water, there was 1 sample of mineral water, 2 samples of filtered water from different homes, and 3 samples of drinking water sold in convenience stores. We found nitrate concentration levels that were higher than the standard in 2 of the 6 samples (33%).

Conclusion: Nitrate is a chemical that is found in food naturally but in some food, especially processed foods, it is used for preserving food. In food like processed food, there are sometimes too much nitrates in there which affects the human body so we have to be cautious when buying processed food.

**Keywords—nitrate, nitrite, processed meat, vegetable, water**

### I. INTRODUCTION

Food is important to humans, it is used to sustain life and increase people's health however unsafe foods can damage health too. Unsafe food containing harmful bacteria, viruses, parasites or chemical substances cause over 200 different diseases from diarrhea to cancer. Around the world almost 10% of the global population falls ill to contaminated food each year resulting in 420,000 deaths [1]. Norovirus is a very contagious virus that causes vomiting, nausea, stomach pain and diarrhea, you can get it from having direct contact, consuming contaminated food or water or touching contaminated surfaces then putting the hand in your mouth. Norovirus is the leading cause of vomiting and diarrhea from stomach/ intestine inflammation in the US. On average, in the US, within a year there are 19-21 million cases of vomiting and

diarrhea, over 2 million visits to clinics, over 450,000 emergency department visits, 100,000 hospitalizations and 900 deaths, mostly in elderly. It causes 58% of foodborne illnesses in the US and costs about \$2 billion, due to lost productivity and healthcare expenses. The infections could be reduced by washing fruits and vegetables thoroughly, cooking food thoroughly, and quarantining yourself if you have the virus [2]. It isn't just viruses and bacteria making food unsafe, chemical additives also can be toxic to humans in large amounts, some are used against regulations such as cobalt in beer or it may be due to using too much of a substance such as nitrate and nitrite in foods such as cheese or fish, finally there are hypersensitivity to food additives such as tartrazine and other food additives. Government organizations test foods but some substances can still get past the

restrictions and tests which cause many hazardous diseases in public health[3.] Unsafe food causes a cycle of disease and malnutrition, affecting vulnerable people. Food safety can not only get rid of the cycle but also supports national economies, trade and tourism, stimulating a sustainable environment. With the globalization of food trade, a growing world population, climate change and rapidly changing food systems, food safety has never been more important.

Meat is an essential part of the human diet. There are mainly two types of meat; processed meat and unprocessed meat. Extensive research has shown that processed and red meats, such as sausages, are generally considered unhealthy and have been linked with chronic diseases, more so than unprocessed meat. The main factors for causing such risks are chemicals called nitrates and nitrites, which are typically added to preserve the red color of meat. They also improve flavor by suppressing fat oxidation and prevent the growth of bacteria. These benefits, however, do not outweigh the consequences. It is advised to only consume up to 125 milligrams of sodium nitrite and 500 milligrams of sodium nitrate per kilogram. Nitrates help form N-nitroso compounds, which are known as cancer-causing substances, and nitrites can cause oxygen deficiency as it binds to hemoglobin, rendering it unable to bind with oxygen. There have been two instances where methemoglobinemia, when your body cannot regulate enough oxygen to important tissues, was reported. Once, when a patient had consumed as much as 3137 milligrams of sodium nitrite per kilogram from a sausage, and twice, when a patient had consumed fried chicken fermented in nitrite [4] These red meats also contain a red pigment called haems, which may irritate or damage the cells lining the bowel. This increases the risk of developing cancer. Furthermore, sausages have a relatively high fat and salt content, which is linked to high blood pressure and an increased risk of stomach cancer. Unfortunately, the risk factors that come with sausages are directly related to the meat itself, and not what's been added to it. Although you could buy sausages with higher meat content, it also means you are getting less of the other ingredients

that help reduce the fat content. These include cereals, fruits, and vegetables, which are often added for flavor. The optimal solution is to cut down your consumption of processed and red meats and turn to dishes with high levels of vitamins E and C. [5] More variety in your meals and a balanced diet will also greatly reduce build-up of nitrates and nitrites in your body. There will be harmful chemicals present in most food, and the majority of people aren't even aware of it. You determine what you eat, so be careful of what you purchase and choose to intake.

Sausages are one of the most common foods in Thailand and could be found anywhere which makes it a popular food that everyone eats. In these sausages that everyone eats there are nitrates and nitrites in there . Even though these two chemicals are dangerous to the human body they still add it to our food and it is because nitrate and nitrites are needed to stop bacteria's growth in the food, especially tightly sealed food since bacterias grow easier in these kinds of food. Nitrates and nitrites are very dangerous because it affects the hemoglobin and might cause a disease called Methemoglobin, the symptoms are vomiting, severe headaches, black out, etc. Even though it's very dangerous the government still allows it but with very strict measures. There was a report about how kids got really sick and some even died because of eating sausages that don't meet regular standards and have more nitrates than they are supposed to have [6] [7]In Thailand, most of the sausages have nitrate and nitrites in them to keep the sausage free from bacteria and look fresh. There are many samples of sausages from different brands and these are some of the examples. Twelve sausages were experimented and the amount of nitrates ranged from none being found to 80.5 mg/kg being found. The limit of nitrate in other countries are 80 mg/kg but in Thailand it is 500 mg/kg.All of these sausages are all in the range that is safe enough for us to eat but we still should not eat too much sausages or food similar to it since if we eat a lot there would be a lot of nitrate and nitrites in your bodies which might cause some diseases [8].

Nitrates and nitrites are naturally present in some vegetables, dairy products, and meat [9]. They are added to food, usually processed meat, to preserve it and help delay the growth of harmful microorganisms and bacteria. They are also responsible for the rich red color found in the products. Although some nitrate is beneficial, it could cause much damage to our bodies if too much is consumed. The Ministry of Public Health has issued for no more than 125 milligrams per kilogram of nitrate or nitrite in fermented meat as they are cancer-causing substances and have proved to be harmful to the human body. In this investigation, we have experimented and observed nitrate concentrations in various products that the majority of the populace ingest on the daily. However there are many additives added to many kinds of foods so that it is more appealing to the public which is why we've conducted a research to test for nitrate and nitrites in everyday foods.

**I. Objective**

1. To find nitrate and nitrite in food

**II. Method**

**Sample group**

A total of 18 samples and 6 types of processed meat products, including crab bars, sausage, squid meatballs, seasoned fish balls, normal fish balls and smaller sausages, were randomly collected from a selling place of processed meat products in a department store and from street food shops in Bangkok.





**III. Tools and equipment**

GT-Nitrate test kit in food was used for preliminary analysis for Nitrate contamination of food additives and used in a test paper (2 in 1 test paper; Quantofix brand) for preliminary analysis for Nitrite food additive contamination [10]

**IV. Procedure**





Testing for Nitrate in Sausage and Interpretation  
 We cut the sausage into small pieces and measured out 1gram, then soaked it in 100ml of water. After that we took 1 drop of that water and mixed it with

the nitrate test kit. We also had another test tube without the sausage and used it as the control tube.

Result				
Concentration	300 mg / kg	500 mg / kg	700 mg / kg	1000 mg / kg
Interpretation	If the concentration is 300 mg/kg then the food is safe to consume, at 500 mg/kg it is still safe but contains a risky amount, at 700 and 1000 mg/kg there is more than the standard set by the ministry of health.			





**Testing of Nitrate in Vegetable and Interpretation**

We slice the vegetables into small pieces and weigh it so it would be 1 gram, then add water to the one gram of sliced vegetables. Then we add 20 drops each of solution A to two test tubes. Add a drop of solution B to both of the test tubes and a drop of the water from the vegetables and water we mixed before to one of the test tubes and shake both of them. Lastly, wait and examine the results.

Result				
Concentration	300 mg / kg	500 mg / kg	700 mg / kg	1000 mg / kg
Interpretation	If the results from the solution are light blue, similar color to the first box, then it has 300 mg/kg which is safe to consume. If the solution is light blue but darker than the one before, similar color as the second box, then it is still safe to eat and is within the limit but is more risky than the first color as it would contain 500 mg/kg. If the color from the solution is blue, similar blue as the third box then it has 700 mg/kg of nitrate which is more than the limit and is quite dangerous to consume in large quantities. If the color of the solution is dark blue like the last box, it has 1000 mg/kg of nitrates which is a lot more than the limit that it can have which means it is dangerous to consume.			

**Testing for Nitrate in water and Interpretation**

First, we put 20 drops of solution A each into 2 test tubes. Then, we put 1 drop of the standard solution D into one of the tubes, and 1 drop of the water sample into the other tube. Next, we lightly shake both test tubes to allow the mixtures to blend together, and leave the tubes for around 1-2 minutes. Finally, we lightly shake the tubes again and observe the color of the mixtures.

Result				
Concentration	3 mg / kg	5 mg / kg	7 mg / kg	10 mg / kg
Interpretation	If the mixture displays a light, sky-blue color, then the solution has a concentration of 3 mg/kg of nitrate, which is safe for consumption. At 5 mg/kg of nitrate, the mixture will become darker, but it is still relatively safe to digest. If the solution has 7 mg/kg of nitrate, it will have a dark blue color, and it is advised to not drink it as it has gone beyond the standard set by the ministry of health. If the solution has a deep blue, or indigo color, then it means that it has a nitrate level of 10 mg/kg and you should not consume it as it can cause serious harm.			

**V. Data analysis**

Analysis of the test results from the GT-Nitrate test kit in food analysis the test should be noticed from the vitro color. When the sample tube is lighter than the B reagent tube of the test kit, the content of Nitrate is less than 500 mg./kg. When the test tube sample is equal to or darker than the standard reagent ampoules of test kit B, indicating Nitrate contents equal to or greater than 500 mg./kg. Analysis of the test paper results (2 in 1 test paper; Quantofix brand) by observing the color on the paper strips and comparing the color with the standard color bar on the product label.

**VI. Result**

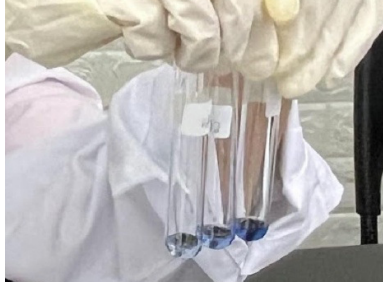


Picture 1: Testing for nitrate in sausage products

From the experiment with the samples of six meat products which are crab bars, sausage, squid meatballs, seasoned fish balls, normal fish balls, and smaller sausages. We found that the amount of nitrate is greater than the limit it is supposed to have. For example, from the samples we used for the experiment we found that all of the samples except for the normal fish balls had 1000 mg/kg of nitrates while the normal fish balls had 700 mg/kg of nitrates. So in conclusion, all of the sample has more nitrates than its limit and is dangerous if we eat a lot of it.

Table 1. Testing for nitrate in sausage products (n=6)

No.	Sausage Samples	Concentration of Nitrate Detected
1	Crab bars	1000 mg/kg
2	Sausage	1000 mg/kg
3	Squid meatballs	1000 mg/kg
4	Seasoned fish balls	1000 mg/kg
5	Normal fish balls	700 mg/kg
6	Smaller sausage	1000 mg/kg

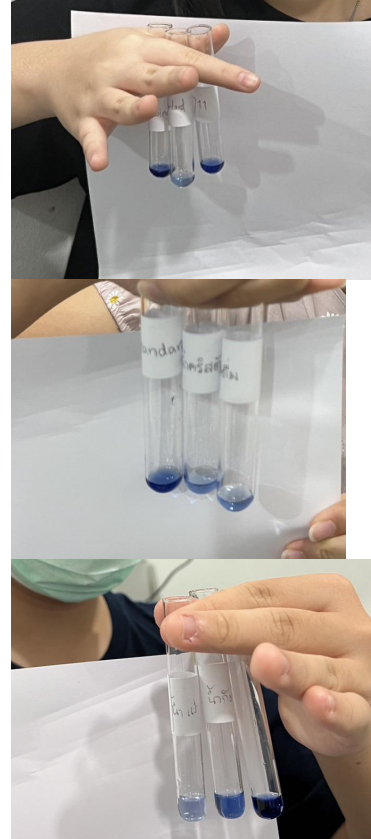


Picture 2: Testing for nitrate in fresh vegetable

From the experiment of testing the concentration levels of nitrate in the 6 vegetable samples; consisting of eggplants, lentils, cucumbers, kale, cabbages, and carrots, we found that all of the vegetable products had nitrate levels that fit the standard as follows; eggplants, kale, and cabbages have a concentration of 25 mg/kg of nitrate and lentils, cucumbers, and carrots have a concentration of 15 mg/kg of nitrate. In conclusion, all the 6 samples of vegetables have an appropriate nitrate concentration level and are safe for consumption.

Table 2. Testing for nitrate in fresh vegetable (n=6)

No.	Vegetable Sample	Concentration of Nitrate Detected
1	Eggplants	25 mg/kg
2	Lentils	15 mg/kg
3	Cucumbers	15 mg/kg
4	Kale	25 mg/kg
5	Cabbages	25mg/kg
6	Carrots	15 mg/kg



Picture 3 : Testing for nitrate in water

From testing the 6 different waters we've tested (mineral water, 2 filtered waters, and 3 waters from different brands in convenient stores) we can conclude that 2 out of the 3 brands in the convenient stores contain more nitrate than it should, this means that the amount of nitrate in it is higher than the recommended amount by the ministry of health. The 2 from the convenient store contains 10 mg/kg whilst the other one from the convenient store contains 3 mg/kg, the mineral water also contains 3 mg/kg and the 2 from the home filtered water contains 7 mg/kg.

Table 3. Testing for nitrate in water (n=6)

No.	Water samples	Concentration of Nitrate Detected
1	Mineral Water	3 mg/kg
2	Filtered water from home 1	7 mg/kg
3	Filtered water from	7 mg/kg

	home 2	
4	Drinking water from convenient store	3 mg/kg
5	Drinking water from convenient store	10 mg/kg
6	Drinking water from convenient store	10 mg/kg

### VII. Conclusion

Of the 18 food samples tested, they consisted of 6 samples of sausage products, 6 samples of fresh vegetables, and 6 samples of drinking water to determine the nitrate content in each product.

Of the sausage product samples, there were a total of 6 samples found that exceeded the nitrate content limit, representing 100% of the total number of samples. The amount detected was 700-1000 mg/kg of nitrate.

Of the fresh vegetable samples, including eggplants, lentils, cucumbers, kale, cabbages, and carrots, there were a total of 6 samples out of the 6 samples found that had a nitrate content that was lower than 25 mg/kg. (0%)

Of the 6 samples of drinking water, there was 1 sample of mineral water, 2 samples of filtered water from different homes, and 3 samples of drinking water sold in convenience stores. We found nitrate concentration levels that were higher than the standard in 2 of the 6 samples (33%)

Nitrate is a chemical that is found in food naturally but in some food, especially processed foods, it is used for preserving food. In food like processed food, there are sometimes too much nitrates in there which affects the human body so we have to be cautious when buying processed food.

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