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Survey Situation of Nitrate Contamination In Meat Products In Ratchaburi Province, Thailand

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Abstract

Background: Nitrate is a kind of chemical that people usually use in the meat process as a food additive and it also can be easily found in any things that humans eat. Mostly used for not letting the food spoil easily, making the food with color of redness and also giving a favor to them as well. However, Nitrate cannot be overdose at the same time because it will affect a human's body by having mild dizziness and lethargy to coma and convulsions.

Objective: To study the prevalence of nitrate contamination in meat products.

Study Method: This study is a cross sectional study which examines nitrate contamination in meat products sold in a daily market and riverside market with a total of 66 samples of Pork Sausage, Chicken Sausage, Pork Meatball, Chicken Meatball, Fish Meatball and Marinated Pork in 11 each of them. These samples are examined by a Nitrate test kit instrument that is especially for food and was used for preliminary analysis for Nitrate contamination of food additives.

Result: A total of 66 samples consisting of fish, pork and chicken meatballs, pork and chicken sausage and marinated pork were examined by using the GT -Nitrate Test. The results showed that 21 samples (31.82%) were found to contain nitrate above 500 mg/kg which consisted of 6 chicken sausage samples, 5 chicken meatball samples, 5 marinated Pork samples, 4 pork sausage samples and 1 pork meatball sample. Nitrate was not detected in any fish meatball sample. On the other hand, it showed that 45 samples (68.18%) were found to contain nitrate lower than 500 mg/kg. All of the fish balls samples showed that their standard amount of nitrate is less than 500 mg/kg. It can be seen that fish balls are a kind of meat process that do not need to use a lot of nitrate in making them because of the texture and the color of it.

Conclusion: As well as said, no matter where you buy the food, always be careful of where it is produced and is eating outside safer than inside. Avoid the food that mostly does not have production address and ingredients because these will constantly add a lot of Nitrate in it. It does not say it cannot be eaten but overeating will cause health in danger

Keywords: Nitrate, Meat product, night market

Introduction

Nowadays, food is a major product that people can't live without. We can easily buy food from anywhere and some of the places even can't buy food even if that place wasn't supposed to sell any kind of food there because it is against the law or rule of that area. The weather in Thailand is extremely hot and the food that others sell in the store might not last longer than usual. So, in the present, society will put a kind of natural chemical in the food for not letting any meat product spoil without any problem. Nitrate is the natural chemical that producers would put in the food that is in meat. [1]

Well, Nitrate is a naturally develop chemical that consists of one nitrogen (N) atom and three oxygen (O) atoms, forming the chemical symbol NO3. Nitrate itself is generally considered safe for health. However, it can become a concern if it is converted to nitrite (NO2). [2] Nitrites and nitrates are food additives used to preserve and protect food from harmful microorganisms, including the dangerous Clostridium botulinum, which causes botulism. Additionally, they are occupied in meats to maintain their red color and enhance flavor. Nitrates are also utilized in the fermentation process to prevent certain cheeses from bloating. These compounds are present naturally in vegetables, with leafy greens like spinach and lettuce having the highest concentrations. Moreover, nitrates can enter the food chain as environmental contaminants through intensive farming, livestock production, and sewage discharge.[3]

Excessive absorption of this natural chemical can pose health risks. Methemoglobinemia, a severe health condition resulting from high exposure to nitrates and nitrites, is the most concerning effect. The scientific demonstration can vary, with symptoms such as oxygen deprivation, cyanosis, cardiac dysrhythmias, circulatory failure, and progressive central nervous system effects, depending on the percentage of total MetHb present.CNS effects can range from mild dizziness and lethargy to coma and convulsions [4]. Nitrates perform essential physiological roles in many systemic processes, such as lowering blood pressure, inhibiting platelet aggregation, and protecting blood vessels. These functions are akin to the effects of nitric oxide (NO). [5, 6]. Nitrate helps protect against ischemic heart disease by promoting vasodilation, increasing blood flow in the epicardial region, lowering vascular resistance, mitigating coronary steel, and reducing preload.

As we can see the situation of Nitrate contamination in meat products in Thailand wasn't getting in any great condition. According to the information from the Smart Buy Testing Center Foundation for Consumers (M.P.) and Consumer Organizations in the Central Region and the Project to Strengthen the Surveillance System of Goods and Services for Consumer Protection, Thai Health Promotion Foundation. Nitrate was detected in 17 samples of sausage products in Ayutthaya province. The amount ranges from 20.67-112.61 mg./kg. According to the Notification of the Ministry of Public Health (No. 418) B.E. 2563 (2020), the use of Nitrates in meat products that have been processed by heat is prohibited Therefore, the objective of this study is to detect Nitrate contamination in traditional processed meat products sold at flea markets and shopping malls.

Objective

To study the prevalence of nitrate contamination in meat products.

Study Methods

This study is a cross sectional study which examines nitrate contamination in meat products sold in a daily market and riverside market in Muang, Ratchaburi Province.

Population and Sampling

A field survey of 3 types of processed meat products were randomly sampled: sausage, fermented pork, and meatball. A total of 66 samples from 2 big appointed markets in Muang, Ratchaburi Province. 22 sausage samples (pork and chicken), 11 marinated pork samples, and 33 meat ball samples (fish, pork and chicken) samples were randomly collected for two days during 09 - 10 July 2023.

Table No. 1 illustration of sample types and numbers

Sample Type	No. of sample
Pork Sausage	11
Chicken Sausage	11

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Pork Meatball	11
Chicken Meatball	11
Fish Meatball	11
Marinated Pork	11
Total	66

Instrument [16]

GT-Nitrate test kit. A test kit instrument for experiment especially for food and 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.

Included with:

1. Reagent 35 tests / bottle, amount 2 bottles
2. Standard reagents A, B, C, D, 1 bottle each type
3. Sample dropper bottle 3 bottles
4. 7 small glass tubes

Minimum detectable value: in water 2 parts per million (ppm.)

Interpretation [16]

The test result analysis by interpreting the test result's color that occurred in the test tube . If the color is lighter than the test kit's standard reagent B tube, it shows that a nitrate content is less than 500 mg/k. On the other hand, if the sample of the tube's color is equal or darker than the standard reagent tube B of the test kit, that means the nitrate that it contains is equal or greater than 500 mg/k.

Table No.2 name

Sample	1 gram of the sample with the water in milliliter	Standard Reagent A mg/kg	Standard Reagent B mg/kg	Standard Reagent C mg/kg	Standard Reagent D mg/kg	Interpretation
Meat product; Ham, sausage, Bacon, etc.	1 gram of sample: water of 100 milliliter	300	500	700	1000	If the color in the sample tube is equal to or darker than the color in the standard B reagent tube, this sample has a concentration equal or greater than 500 mg/kg, exceeding the fresh content set by the Food and Drug Administration. Not more

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						than 500 mg/kg.

Result interpretation by analyzing the test results

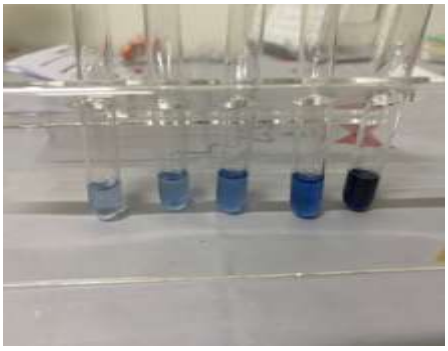
from the color that occurred in the test tube. If the color is weaker than the test kit's standard reagent B tube, it indicates a nitrate content of less than 500 mg/k. When the sample tube's color is equal to or darker than the standard reagent tube B of the test kit, it indicates that the nitrate content is equal to or greater than 500. mg/kg.

Data Analysis

Descriptive statistics were used to find the frequency, percentage and mean.

Result

Picture No. 1 Illustrate test result.



Tube No. 1 is the result from the sample,

Tube No. 2 is the Standard Reagent A,

Tube No. 3 is the Standard Reagent B,

Tube No. 4 is the Standard Reagent C

Tube No. 5 is the Standard Reagent D

In the 66 samples of pork sausage, chicken sausage, pork meatball, chicken meatball, fish meat and marinated pork of each of 11 samples. The nitrate that are above 500 mg/k from the highest to the lowest are chicken sausages; 6 (54.54), chicken meatballs and marinated pork are equally ; 5 (45.45), pork sausages ; 4 (36.36), pork meatballs 1 (9.10) and lastly fish meatballs ; 0 (0.00). The nitrate that are below 500 mg/k based from the highest to the lowest ; fish meatballs ; 11 (100.0), pork sausages ; 7 (63.54), chicken meatballs and marinated pork are same amount ; 6 (54.55), and to the last is chicken sausages ; 5 (45.46).

The total of both above 500 mg/kg and below 500 mg/kg are 45 (68.18) and 21 (31.82).

Table 1. No. and percentage of sample detected Nitrate categorized by type of sample (n=66)

Sample Type	**No. of sample**	**Result**	
		Below 500 mg/kg n (%)	**Above 500 mg/kg n (%)**

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Pork Sausage	11	7 (63.64)	4 (36.36)
Chicken Sausage	11	5 (45.46)	6 (54.54)
Pork Meatball	11	10 (90.90)	1 (9.10)
Chicken Meatball	11	6 (54.55)	5 (45.45)
Fish Meatball	11	11 (100.00)	0 (0.00)
Marinated Pork	11	6 (54.55)	5 (45.45)
Total	66	45 (68.18)	21 (31.82)

Discussion

The aim of this study is to find out the amount of Nitrate in the food that is not sold in the supermarket, not verified by the government of Thailand or the Food and Drug Administration and also wanted to find out which kind of meat products have the least Nitrate in them and the amount of Nitrate in each of the meat products.

A total of 66 samples consisting of fish, pork and chicken meatballs, pork and chicken sausage and marinated pork were examined by using the GT - Nitrate Test. The results showed that 21 samples (31.82%) were found to contain nitrate above 500 mg/kg which consisted of 6 chicken sausage samples, 5 chicken meatball samples, 5 marinated Pork samples, 4 pork sausage samples and 1 pork meatball sample. Nitrate was not detected in any fish meatball sample.

This may be because it depended on the use of Nitrate in the processed meat to inhibit the growth of bacteria and the properties of Nitrate gave the food a red color. Therefore, it is widely used in processed meat such as, sausage, Chinese sausage, fermented pork [7]. On the other hand, the use of Nitrate in meatballs may be because of stopping the growth of bacteria in the processed meat for not letting it spoil easily. The Ministry of Public Health has set the use amount of Nitrate in the processed meat not over 500 milligrams per kilogram [8] The detection of Nitrate is excess the amount that is prescribed by the Ministry of Public Health. It may be because the product is sold in the night market that's why the product does not have the FDA standards.

This may be because of the texture of the meat that needs to use more nitrate than usual or as the Food and Drug Administration has been prescribed in law of Thailand and mostly the samples that have used Nitrate over 500 mg / kg are chicken sausages, chicken meatballs and marinated pork. The results of this study are consistent with the study of THAI FOOD AND DRUG JOURNAL [9] that detects nitrates from a random sample from a Flea Markets in Bang Phra Sub-district Municipality, Si Racha District, Chonburi Province

Nitrate was detected in chicken and pork sausage and meatballs. This is because collagen is the major reason that they need to use Nitrate more than usual. Collagen is the component of skeletal muscle, making up much of the connective tissue between and around muscle fibers.

It's important to note that the use of nitrate in chicken products can vary depending on the specific product and manufacturing process. While the use of nitrate in chicken products can provide benefits in terms of food safety, flavor, and appearance, it is important for manufacturers to follow appropriate guidelines and ensure that the levels of nitrate are within acceptable limits to maintain consumer safety. It is always advisable to refer to product labels and consult with the manufacturer for specific information on the use of nitrate in a particular chicken product.[10]

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As well as the marinated pork because mostly the ingredients that used contain Nitrate such as; raw spinach, beets, celery and lettuce. That's why Nitrate in marinated pork can be over 500 mg / kg.[11]

From the result, Nitrate was not detected in any of the fish meatball samples. It is not accurate to say that nitrate is used less in fish balls. In fact, nitrate is not typically used as an ingredient in fish ball production. Fish balls are commonly made by grinding or blending fish meat into a paste, adding other ingredients such as starch, flavorings, and seasonings, and then shaping the mixture into balls or other desired forms. The mixture is then cooked by boiling, steaming, or frying. [12]

Nitrate is a chemical compound that is often used with food preservation, especially in processed meats such as cured or smoked products. It helps inhibit the growth of harmful bacteria and extends the shelf life of these products. However, fish balls are generally considered fresh or minimally processed foods and are not typically subject to curing or preservation methods involving nitrate. [13]

It's important to note that the use of food additives, including nitrate, can vary based on regional or cultural practices and specific product recipes. However, in the context of traditional fish ball preparation, nitrate is not a commonly used ingredient.[14]

Moreover, fish muscle has much lower amounts of collagen than the muscles of land animals. Collagen is a major component of skeletal muscle, making up much of the connective tissue between and around muscle fibers. The amount of collagen in meat determines, in large part, its texture. Meat with more collagen will be less tender than meat with less collagen. In addition, fish balls naturally do not need any color in them as well. That’s is another reason that why fish balls mostly are less than 500 mg/kg

[15]

Pork is because of the natural redness of it. This is also the reason why pork products don't use Nitrate over 500 mg / kg the same as the fish product.

Conclusion

A total of 66 samples consisting of fish, pork and chicken meatballs, pork and chicken sausage and marinated pork were examined by using the GT - Nitrate Test. The results showed that 21 samples (31.82%) were found to contain nitrate above 500 mg/kg which consisted of 6 chicken sausage samples, 5 chicken meatball samples, 5 marinated Pork samples, 4 pork sausage samples and 1 pork meatball sample. Nitrate was not detected in any fish meatball sample. On the other hand, it showed that 45 samples (68.18%) were found to contain nitrate lower than 500 mg/kg. All of the fish balls samples showed that their standard amount of nitrate is less than 500 mg/kg. It can be seen that fish balls are a kind of meat process that do not need to use a lot of nitrate in making them because of the texture and the color of it.

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