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A Case study: Nitrate in Processed Meat Products sold in Convenient Stores and Supermarkets in Bangkok, Thailand

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Abstract: **Background: Currently Nitrate is a food preservative that is used in processed meat products for longer shelf life, and causes desirable color and odor of the products.**

Objectives: The objective of this study is to investigate the contamination of Nitrate that exceeds standards in the western processed meat products from convenient stores and supermarkets.

Methods: The study collected 17 western processed meat product samples in June 2022 from convenient stores and supermarkets in Bangkok, Thailand and investigated the contamination of Nitrate with GT-Nitrate test kit.

Results: There was 17.65% of the samples which was not met the Nitrate exceeded standard value according to the regulations on the usage of food additives, the Notification of Ministry of Public Health number 389 in B.E. 2561 (2018), Re; food additives (number 5) determine to use Nitrate exceed than 500 mg. per kg. The 2 samples of ham products (50%) had the highest amount of Nitrate contamination that did not meet the standards also, followed by 1 sample of sausage product (16.67%). In addition, the bacon and bologna products were not found to have Nitrate contamination that exceeded standard value.

Conclusions: This study showed that we found a few of western processed meat products in convenient stores and supermarkets which were contaminated with Nitrate, it demonstrated that there is still used Nitrate by over the standard generally.

Keywords: **Nitrate, Nitrite, western processed meat products.**

1. INTRODUCTION

Nowadays, consumers tend to consume more processed meat foods because it is convenient and widely available. However; it is considered as high risk of cancer caused by adding preservatives such as Nitrate salt, Nitrite salt or Potassium Nitrate (KNO_3) to food to preserve the color, smell, taste to be fresh and pleasant to eat, but too much amount can be harmful to consumers. Nitrosamine was first discovered in 1954 by British scientist, John Barnes and Peter Magee.[1] They both found

that Dimethyl Nitrosamine (Dimethyl Nitrosamine: NDMA) causes liver cancer in rats. This led many scientists to study other Nitrosamines, for example by examining about 300 N-Nitroso compounds. It appeared that 90% is a heterogeneous and organ-specific carcinogen, such as Trimethyl Nitrosamine, causing liver cancer in laboratory animals.

Nitrate compounds, especially in the form of salt, are widely used as food additives in meat processing such as ham, bacon, sausages, fermented pork, Chinese sausage, etc.[2] because they can help prevent the growth of Anaerobic bacteria in particular. Clostridium botulinum also maintains color fixation, producing a desirable color and odor in these products. Nitrate can be converted to Nitrite through reactions that occur in the body. When Nitrate are ingested, it will be converted to Nitrite by bacteria in the mouth and stomach. In addition, storing food at inappropriate temperatures can also cause the conversion of Nitrate to Nitrite. Nitrate can react with hemoglobin (Hemoglobin:Hb) and undergoes a structural change to Methemoglobin. (Methaemoglobin) and makes hemoglobin unable to bind to Oxygen. As a result, the transport of Oxygen to cells is reduced. When the amount of Methemoglobin increases, cellular hypoxia becomes more severe, leading to cyanosis, fatigue, shortness of breath, headache and rapid heartbeat, etc.[3-4] Joint FAO/WHO Expert Committee on Food Additives (JECFA), the daily intake of Nitrate and Nitrite without causing harm to health over the lifetime (Acceptable Daily Intake: ADI) is 0-3.7 mg./kg; and 0-0.07 body weight per day[5] and from the Notification of the Ministry of Public Health No. 389 B.E. 2561 (2018) to limit the using of Potassium Nitrate or Sodium Nitrate in marinated meat products, such as sausages, not more than 500 mg./kg[6].

From the epidemiological research data presented, it was found that consuming 50g. of processed meat daily increases the risk of colon and rectal cancer by 17%, or equivalent to 4 slices of bacon or 1 slice of sausage, etc.[7] According to a survey on processed meat products in Thailand, such as sausages, over 900 samples were found contaminated with Nitrate above the standard 20%[8], including chicken sausages, pork sausages, Chinese sausages, fermented pork and Vietnamese sausages were found that it is Nitrate contamination over standard value in chicken sausages, pork sausages and Chinese sausages 5.1, 3.6 and 6.6%, respectively,. Nitrate is also found in food products with no specified amount of usage. If the body is taken Nitrate in large quantities or regularly it can be harmful. Therefore; Nitrate and Nitrite contamination in western processed meat products sold in department stores was studied.

Objectives

1. Study of Nitrate contamination in processed meat products sold in department stores and flea markets in Bangkok.

2. Compare the Nitrate contamination in each processed meat product to provide information to the agencies that are responsible for controlling the production and distribution of mentioned food as required by law.

2. METHOD

Sample group: 4 types of processed meat products; sausages, bacon, ham and bologna were randomly collected from 17 processed meat products in department stores and flea markets in Bangkok.

Tools and equipment: GT-Nitrate test kit in food is used for preliminary analysis for Nitrate contamination of food additives by using a test paper (2 in 1 test paper; Quantofix brand) for preliminary analysis for Nitrite food additive contamination.

Data Analysis: Analysis of the test result is noted from the in vitro color. When the sample tube is lighter than the B standard reagent tube of the test kit, it means the content of Nitrate is less than 500 mg./kg. and when the test tube sample is equal to or darker than the standard reagent ampoules of test kit B, it indicates Nitrate content equal to or greater than 500 mg./kg. Analysis of the test paper results (2 in 1 test paper; Quantofix brand) can notice the color on the paper strips and compare the color with the standard color bar on the product label.

3. RESULT

1) The result of the analysis of Nitrate contamination above the standard value in all 17 samples of processed meat products showed that 3 samples, equivalent to 17.65%, found that the Nitrate content exceeded the standard value at 500 mg/kg. and when categorizing the sample analysis result according to the type of western processed meat products, it was found that ham had the highest Nitrate content of 50%, followed by sausage at 16.67%. Bacon and bologna did not find any Nitrate that exceeded the standard as shown in Table 1.

Table 1: The number of 17 samples of Nitrate salt analysis in sausages, bacon, ham and bologna sold in department stores and flea markets in Bangkok

Type of Products	Number of samples (a)	The number of samples in which Nitrate salt were detected (b)	Percentage (b/a) *100
Sausage	6	1	16.67
Bacon	3	0	0
Ham	4	2	50
Bologna	4	0	0
Total	17	2	17.65

2) From the result of the analysis of Nitrate and Nitrite contamination in 15 samples of western processed meat products, 2 samples, Ham and Sausage; were found Nitrate content was 500 mg./kg. which above the standard value, the color of the sample was darker than the standard B reagent tube of the test kit. When Nitrite contamination was analyzed by a test paper (2 in 1 test paper; Quantofix brand), the use of Nitrite salt was not found in samples of western processed meat products.

Table 2: The content of Nitrate and Nitrite salts in 17 samples of sausages, bacon, ham and bologna sold in department stores and flea markets in Bangkok

Type of Products	Number of samples	Nitrate & Nitrite quantity (mg./kg.)			
		Nitrate		Nitrite	
		Color	Below the standard	Color	Below the standard
Sausage	6	a bit darker	1	Not found	0
Bacon	3	lighter	0	Not found	0
Ham	4	darker	2	Not found	0
Bologna	4	lighter	0	Not found	0
Total	17		3		0

4. DISCUSSION

Nitrates and Nitrites are used in a variety of processed meat products. This prevents the growth of Clostridium Botulinum bacteria and helps to fix the color, producing a desirable color and odor. When Nitrate enters the body, it is converted to Nitrite by bacteria in the mouth and stomach reacting with hemoglobin causing severe oxygen starvation, cyanosis and other symptoms such as fatigue, shortness of breath, headache, heart beat faster than usual[3-4]. If taken in small amounts over a long period of time, it can cause chronic toxicity and a risk of cancer in various organs such as pancreas, respiratory tract, bladder, liver, kidneys, stomach and intestines, etc. When considering the results of the sample collection and analysis, western processed meat products such as sausages, bacon, ham, bologna, 17 samples sold in department stores and flea markets in Bangkok in this study, 3 samples of western processed meat products had Nitrates exceeded the standard by 500 mg./kg., sausage and ham. (There were 2 samples) representing 50%, followed by sausages at 16.67%. Bacon and bologna were not found to contain Nitrate content that exceed the standard.

The reason for the detection of Nitrate in the above example is likely that the manufacturers or such products contain Nitrates to extend the life of products. Nitrate will slow down the oxidation of fat and also help to inhibit the growth of pathogens. It also helps to fix the color or stabilize the color to make the product more palatable. It will be added to processed meat products of various types of marinated meat such as ham, etc.[2,9] Sometimes Nitrates are added that exceed the standard according to the Notification of the Ministry of Public Health No. 389 B.E. 2561 (2018) regarding additives; Food (No. 5) that has been prescribed the Announcement of the Ministry of Public Health stated that "The use of 2 or more types of food additives in the same function group shall be combined in quantity not exceeding the quantity of food additives of the specified type to be used the least". It means if any type of products uses Nitrite only, there should be no more than 80 mg. of Nitrite per kg. of food, or if using Nitrates only, 500 mg of Nitrate per kg. of food is permitted as required by law. But if any product uses both Nitrites and Nitrates, the amount usage when combined must not exceed 80 mg./kg. to prevent harm that may cause to consumers[5.]

The results of this study are consistent with the study by Sanhat Choosang and colleagues who collected samples of sausages, fermented pork and ham from market places in Bang Phra Subdistrict Municipality, Chonburi Province, 135 samples were found to be contaminated with Nitrate exceeding the standard (500 mg./kg.) at 4.4%. The most contaminated products with excess Nitrate content were fermented pork, 4 samples, representing 8.8%, Ham 2 samples, representing 4.4% and found that all 3 markets had processed meat products contaminated with Nitrates above the standard and found this weekly[10]. It is also consistent with a study by Wenika Benjapong and colleagues that analyzed Nitrate and Nitrite content in processed meat products sold in Bangkok and provinces in 5 regions of 1,024 samples. There was found Nitrate content that exceeded the standard in the products of chicken sausage, pork sausage, Chinese sausage and pork sausage by 0.4, 3.6, 6.6 and 4.3%, respectively. Moreover; it was found the highest Nitrate content in the samples as high as 628.2, 2,590, 2,764 and 86.10 mg./kg., respectively[4], in line with this research of Nitrate contamination (more than 500 mg./kg.) that has been found in western processed meat products including ham and sausage There is also a study of the situation of food additives in meat products in Nakhon Ratchasima Province 2017 by Boonsong Leesuraplanonda, it was found that 19 samples of sausages contain Nitrate in 2 samples, 14 samples of fermented pork contain Nitrate in 2 samples and contain Nitrite in 3 samples and 28 samples of Chinese sausages contain Nitrate in 11 samples.[2].

5. CONCLUSION

The result of this study found that western processed meat products including sausages, bacon, ham and bologna contain above-average Nitrate content in hams and sausages. But when compared to the total number of samples, it was found that there were not many. At present, Nitrates are still used for the purpose of preserving food, maintaining the quality of food, preventing changes in odor, color, and prolonging shelf life. It also gives food an appetizing color by creating a reddish-pink color, which is a potential risk of using Nitrates in processed meat products higher than the legal limit that may adversely affect the consumers' health.

6. RECOMMENDATION

1) There should be training to educate entrepreneurs to be aware of the danger of Nitrate contamination that exceed the standard in food to create understanding and make it safe for consumers.

2) There should be co-operation between the relevant officials of the operators and personnel of the Ministry of Public Health to regularly check the use of additives in processed meat products at various selling places such as flea markets, stalls, etc.

3) Consumers must be aware of food choices by observing processed meat foods that are not too bright red than the natural one or should select to consume processed meat products that have been certified to international production standards. Avoid processed foods with a high content of Nitrates, which will result in a large amount of these substances being consumed by the body and accumulated over a long period of time and arise the risk of cancer, which can cause health hazards.

4) Consumers should eat processed meat products in moderate quantity to reduce the risk of exposure to Nitrates accumulated by the body.

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