

UPDATE: NITRITE FREE MEAT PRODUCTS

by
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SUMMARY

Discussion includes: 1) changes in Norwegian regulations for the use of nitrate and nitrite in food products, 2) the current situation for the legal and illegal use of nitrite in meat products (nitrate has been banned in Norway since 1973), and 3) the current nitrate/nitrite situation for meat and meat products in Denmark, Finland, France, Holland, Hungary, Sweden and West Germany.

I. INTRODUCTION

Discussions about the necessity for, and, the risks of, using nitrate and nitrite started in Norway about 15 years ago. Norwegians heard Swedish consumers trying to obtain a ban of nitrate and nitrite by 1969. In 1973, nitrate was banned from Norwegian meat products and limitations on the use of nitrite was first seen.

Dinner sausages and other dinner meat products appear grey in the absence of nitrate or nitrite and are not as marketable as meat with a pinkish red color.

This fact has created problems for bigger sausage producers. Some of the competitors still have products with some pinkish red color, especially on the surface of the sausage products. Health authorities are also involved in this problem for it is difficult to determine chemically if a product contains nitrite, and, at present, no "on the spot" inspection control.

In this paper the meat nitrate-nitrite situation in the above mentioned European countries is described. It will become apparent to the reader that Norway has the strictest regulations for the use of nitrate and nitrite in meat products. Only the future will tell if this strict line in the nitrate-nitrite question has been correct.

II. HISTORICAL REVIEW

The history of Norway's nitrate/nitrite question is interesting.

About 15 years ago nitrosamines were found in animal feed concentrate made from Norwegian herring meal. It was also found that such substances could be formed in food for humans under special conditions.

In the late 1960's authorities said a ban on nitrite and nitrate in food products would be likely.

In 1972 negotiations began between health authorities and those members of the food industry using nitrate and nitrite including processors of fish, meat and cheese. The result of negotiations was the first ban (as it was called) on nitrite effective January 1, 1973.

Exceptions from the ban were given to certain food products.

The word "ban" on nitrite and nitrate has been substituted with the word "limitations" by Norwegian health authorities because the positive list of additives in Norway is really meant to be positive in its philosophy. Limitations on the use of nitrite have developed gradually since 1973 in Norway.

By 1973 it was apparent to health authorities that nitrite could be removed from dinner products such as knockwurst, Vienna sausages and frankfurters, but still be allowed in dry cured products, products intended for slicing and sandwich use, and special meat products such as cooked cured beef and bacon.

It was then decided that nitrate and nitrite should no longer be allowed in fish and fish products with the exception of the growth of *Clostridium Botulinum*. However, fish and fish products which had been cured and packed already were exempt. It was five years before any trace of nitrite and nitrate could be detected in fish and fish products. For all practical purposes, then, the elimination of nitrate from all fish products was not until 1978.

Cheese producers agreed to a reduction of the use of nitrate in 1973. By 1974 the amount of nitrate in cheese milk had decreased to 150 ppm, which is the present standard for some specified cheeses of the gouda type.

With meat products, nitrate was taken out because

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it is the nitrite that has any effect, and, also, a more correct addition could be done when using nitrite. This was in 1974. No further changes were made until 1978 when the health authorities tolerated the color increasing effect of nitrite and placed a limit of 60 milligrams per kilo. This limit was allowed for cosmetic reasons for sliced products but not in sausages such as frankfurters, wieners and knockwurst.

The other aspect was the preservative effect of nitrite, which was resolved by allowing an additional 200 mg/kilo to dry cured products such as dry cured hams, salami sausages and canned pasteurized meat products.

The final limitation was announced in December 1978: Effective January 1979, 60 mg of nitrite per kilo could be added to cured products intended for slicing. The reason was that these products either were so strongly salted no danger of *Clostridium Botulinum* was present or they would be cooked immediately before consumption, which would destroy the toxin from *Clostridium Botulinum* (the botulinum toxins are thermolabile).

Professor Hans Kolbein Dahle, of the Veterinary College of Oslo and a consultant for the Norwegian Health Authorities, stresses that no longer any ban nor limitation exists, but, instead, a positive list of products not containing nitrate. A change, such as the addition of nitrite to a product (which means its elimination from the positive list), will be informed about immediately. The positive list of additives is published each December and is effective January of the following year.

Reports about reductions in the sale of nitrate and nitrite

Companies selling nitrite and nitrate, as well as normal sodium chloride, report a reduction in sale of salt (NaCl) containing 0.6% nitrite.

One company reports a sales drop for curing salt 5.2% in 1978 and 38% decline in the first 5 months of 1979 compared to the same period last year. The companies selling salt and salt containing 0.6% nitrite say they are not interested in offering a mixture of salt containing only 0.3% nitrite in the salt.

However, if 60 milligram nitrite per kg. is allowed to be added in meat products containing about 2% salt, this mixture might be convenient. Currently, sausage factories have to "dilute" the salt containing 0.6% nitrite with salt not containing nitrite. Suppliers continue to sell salt containing 0.6% sodium nitrite even though salt containing 0.5% sodium nitrite is allowed.

III. CURRENT GENERAL USAGE OF NITRITE IN NORWAY

1. A total ban on the use of nitrite in cured meats has not been made. The use of nitrite has been discontinued primarily in dinner sausages like knockwurst, frankfurters, Vienna sausages, etc. Nitrite is permitted as an additive in bacon, bologna, salami and pasteurized — not sterile — canned products.

Nitrite is generally allowed in all sliced products designed for use as sandwich meats. Whole sausages which customers usually slice at home for use in sandwiches may have added nitrite if the sausage is labeled "Meant for slicing."

2. Norwegian food regulations regard nitrite and nitrate as food preservatives or color stabilizers depending upon the type of food product.
3. Nitrate is used in the dairy industry when added to cheese milk.
4. Nitrate and nitrite cannot be added to any other food products in Norway. In drinking water, a maximum of 2.5 ppm nitrate — N and 0.05 ppm Nitrite — N is accepted.

Varied acceptance of the new regulations by the Norwegian meat industry

The new regulations have been accepted more readily by larger meat packing firms than by smaller units. Some Norwegian meat processors have been able to establish an outer layer of red coloring by one or more of the following methods, *all* of which are illegal:

1. Adding salt containing 0.5% nitrite or adding salt with lesser amounts of nitrite, which causes a red coloring throughout the sausage with no grey center.
2. Adding (spraying) a water solution of curing salt containing nitrite to the cooking chamber immediately after placing the sausages into the cooking chamber. Analytical results will show very little or no residual nitrite in the products.
3. Adding curing salt containing nitrite to the smoking sawdust.
4. Smoking the sausages without nitrite in the same chamber as sausages legally containing nitrite or together with other meat products legally containing nitrite.
5. Placing dinner sausages in a smokehouse where products containing nitrite were smoked a few hours earlier.

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6. Adding meat trimmings from products legally containing nitrite to non-nitrite products like frankfurters and other dinner sausages. This gives a pink-red color throughout the sausages.
7. Using second quality "milk powders" illegally containing whey powders which has nitrate from the second draining of whey.

Consumer acceptance

Consumers seem to accept the grey-colored sausages. Consumption of these sausage types had declined initially, but later returned to the normal level. However, given the choice of a grey-colored or a red-colored sausage, the consumer still prefers the red product. When only the grey product is available, it will be purchased. Although some major producers hope consumers will request the grey products even when red products are available, the consumers still purchase the red products. Consumer organizations claim consumers want the choice of products with or without nitrite.

The health authorities have experienced difficulty enforcing the regulations, especially in smaller plants. They do report a significant decrease in the use of nitrite. Health authorities feel larger companies in the meat industry have accepted the regulations.

However, the larger companies do not believe the health authorities are making an honest attempt to enforce the regulations in smaller plants. Efforts have been made to pressure smaller operations into complying with the regulations.

Unofficially, it is believed that 5 ppm of residual nitrite occurs naturally in products and that the local authorities have accepted this as the maximum limit, contrary to the opinions of the central authorities. This small amount is enough to produce a pinkish color on the surface of the non-nitrite products. Anything more than 5 ppm residual nitrite is considered by some local health authorities as a deliberate addition. Some of the illegal methods mentioned before can be used and will not show a residual of 5 ppm. Consequently, authorities cannot control these violations.

Tests have been conducted at the Norwegian Meat Research Laboratory using carbon monoxide to give products a pink color. One firm has patented an outer pink-colored method through the use of propane gas. (This is also an illegal method.)

The industry does not feel the present situation is satisfactory. Since it appears the officials in charge of enforcement have ignored the problem, an increase in

the addition of nitrite has been made by some producers.

To date, no reported outbreaks of botulism from consumption of non-nitrite cured meats have been made.

Shelflife in Norway

We have had no real problems with shorter shelf life of no-nitrate/nitrite sausages used for dinners.

As everyone knows, Norway is not far from the North Pole. The average temperature is lower than Brookings, S.D. Because the polar circle crosses Norway in the center, the northern parts of Norway have the midnight sun in the summer, which makes the temperature quite high even in the night.

I personally believe the cooling chain is more effective in the United States than in many parts of Norway. This means nitrite-free products in the U.S. will have at least the same shelf life as similar products in Norway. This, of course, does not mean that shelf life is not reduced in relation to products when nitrite is added.

Nitrite-free meat products in Norway

"Medisterpølse," a pork sausage, has been consumed cooked and unsmoked without any addition of nitrite or nitrate for many years. No reported accidents have resulted. The shelf life of medistersausage is short because it is only cooked, not smoked. Also, in other countries, sausages might be seen without nitrite or nitrate. This is one fact that has been taken as an indication of the safety of nitrite-free dinner sausages.

In Norway many products are homemade on farms and nitrite or nitrate were never added. Liver paste and meat patties as well as "karbonader" — fine pure ground beef burgers — are all nitrite-free and have been consumed for years.

These facts perhaps make the authorities believe no danger results in removing nitrite from meat products.

I, and other scientists, are not qualified to discuss food poisoning risks that may result from removing nitrate and nitrite from meat products.

During the last six years we have had several cases of botulism in Norway:

1973: 4	1976: 2
1974: 1	1977: 7
1975: 4	1978: 0

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However, all of these cases have been caused by consumption of a special type of fermented fish called "rafefisk."

Sodium nitrite is allowed in Norway as a color stabilizer and preservative depending on the type of food

Potassium nitrite (E252), like sodium nitrite (E250), is also regarded as a preservative (see below/or explanation of E number). In canned, pasteurized meat products a maximum of 200 milligram per kilo of sodium nitrite is allowed. The addition of sodium nitrite must be in a mixture with NaCl, (0.5%).

For sliced products, like bologna, a maximum addition of 60 mg/kilo of sodium nitrite is allowed and must be used as a "curing salt" (0.5% sodium nitrite mixed with sodium chloride). In this connection it is allowed as a color stabilizer. In canned, pasteurized products it is allowed as a preservative. A maximum of 60 mg. sodium nitrite/kilo may be added to products for slicing made from whole meat pieces as a color stabilizer. Ascorbic acid is allowed in all products where nitrite is allowed.

For dry, cured sausages like salami, maximum 200 mg/kilo is allowed when added in a salt containing 0.5% sodium nitrite.

Milk and other food products

Potassium nitrate or sodium nitrate is allowed in the cheese milk (maximum 150 mg. per kilo cheese milk), when making solid and semi-solid rennet cheeses except cheddar, normanna and norzola.

Use of E-numbers

Authorities claim E numbers should be used for all additives. In the future, nitrite, nitrate and caffeine will be marked with their specific names. The use of E numbers is common in the European Economic Community (EEC). This will be effective in Norway (not a member of the EEC) January 1980.

Declaration of additives like nitrite in Norway

All additives must be declared on the packages.

When salt containing 0.5% sodium nitrite is used, the package shall be labeled, "Nitrite added." Retailers, for example, selling bologna type products with nitrite must display a poster stating the products contain nitrite.

When sodium or potassium nitrate is used for

making certain types of cheeses, the package must be labeled, "Nitrate added."

The same regulations for sodium nitrate and potassium nitrate also apply to products with additives such as melted cheese, food casein and cheese powder.

It must be mentioned that this manuscript has been reviewed by the Norwegian health authorities and their consultant before presentation here in Brookings.

IV. NITRATE/NITRITE SITUATION IN OTHER EUROPEAN COUNTRIES (AS RELATES TO MEAT AND MEAT PRODUCTS)

Denmark utilizes the Norwegian system with a positive list for additives. Additives which are not listed cannot be added to food products. Nitrates and nitrites are in the positive list under "Meat and Meat Products" and nitrate and nitrite are found in the list of preservatives.

Nitrates may be used in Wiltshire bacon and pieces from Wiltshire bacon. It may be used for bacon cured trimmings and for dry sausages and dry hams as well. It may also be used in products which have obtained a long shelf life from long time curing or drying.

The content of nitrate in the finished product must not exceed 500 mg/kilo as KNO_3 .

Nitrite may only be used in amounts up to 175 mg/kilo calculated as NO_2 . Like Norway, it may only be added as a curing salt. The finished products shall not have a content exceeding 75 mg/kilo, and for sterilized products only 25 mg/kilo calculated as $NaNO_2$.

The maximum content in the finished product is interpreted by the Danish health authorities to be "indicative." It must be quite clear before action is taken that the addition has really been too high.

Trimmings from bacon sides and pieces from slicing of products containing nitrate may only be added to heated products in an amount not higher than 15% and only when the meat products are not exported.

Nitrate and nitrite must be labeled on the finished package in either Danish, Norwegian, Swedish, English, German or French.

Nitrite must be labeled as nitrite, not as "nitrite salt" or "curing salt."

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Finland

Finland allows nitrate in cured meat, smoked meat and other meat products such as livers and kidneys.

Pure nitrite is not allowed, only when mixed with salt containing 0.6% NaNO₂.

No maximum limit for the addition of nitrate or nitrite has been set, but the maximum residual nitrate must not exceed 0.5% for nitrite 0.015%.

In the future, the maximum allowed addition of nitrate will probably be 0.03% and for nitrite 0.015%.

The residual nitrate in the future probably will not be allowed to exceed 0.0075% and also nitrite will have a maximum allowed residual of 0.0075% corresponding to 7.5 milligram per kilo.

According to Dr. Mati Pohja of the Meat Research Center in Hameenlinna, nitrate and nitrite will be allowed in Finland in the future.

In Finland, additives having the same effect must not be added at the same time in amounts higher than to a certain limit — 100%. If, for instance, nitrite is added in amount of 0.01% which corresponds to 66.7% of the allowed residual of 0.015%, then the addition of nitrate must not exceed more than 33.3% of the allowed residual of 0.05%. This means that only 0.017% nitrate will be allowed added together with the 0.01% nitrite.

France

The use of nitrate is allowed in all cured meat products, but the use of pure nitrite is forbidden.

Salt containing 0.6% nitrite is allowed in all cured meat products.

Alternatives for the addition of nitrite and nitrate to meat products are divided into three categories:

1. Unground not fermented products:
 - a. Nitrite salt alone: maximum addition 2% = 120 ppm nitrite
 - b. Nitrate (K or Na) alone: maximum addition 0.05% = 500 ppm nitrate
 - c. Nitrite salt and nitrate mixed together: nitrite salt: maximum addition 1.7% = 100 ppm nitrite. + nitrate (Ka or Na). Maximum addition 0.02% = 200 ppm nitrate.
2. Unground fermented products:
 - a. Nitrite (K or Na) alone: maximum addition 0.02% = 120 ppm nitrite

- b. Nitrate (K or Na): maximum addition: 0.1% = 1,000 ppm nitrate + Nitrite salt: maximum addition: 2% = 120 ppm nitrite.

3. Ground products fermented or not:

- a. Nitrite salt alone: maximum addition 2.5% = 150 ppm nitrite.
- b. Nitrate (K or Na) alone: maximum addition 0.05% = 500 ppm nitrate.
- c. Nitrite salt: maximum addition: 2% = 120 ppm nitrite + nitrate (K or Na). Maximum addition: 0.01% = 100 ppm nitrate.

In earlier regulations, France had maximum limits for residual nitrite and nitrate. However, in the new regulation, residual limits have been suppressed and limits apply only for nitrate or nitrite additions.

The relatively new French regulation has significantly reduced the amount of nitrate and nitrite salt in meat products. It is believed that nitrite and nitrate will not be banned from these products in the near future, but should a regulation change occur, nitrate and nitrite will be limited to the amounts necessary for bacterial protection, color, flavor and stability during storage.

Only sodium nitrite is allowed for making nitrite salt (0.6%) and potassium nitrite is allowed in products for low sodium diets.

(Source: R. Goutefongea, Station de Recherches sur la Viande, Inra Theix-63110, Beaumont, France.)

Holland

Nitrate is allowed in all cured meat products and in cheese. Pure nitrite is not allowed in meat products, but the health authorities will allow its use in all meat products by certain factories.

"Nitrite salt" — salt containing 0.6% nitrite — is allowed in all cured meat products, with no maximum limit for the addition of this salt in these products.

A maximum limit of 500 ppm residual nitrate and 200 ppm for residual nitrite has been proposed as well as a proposal replacing the residual limit of nitrate and nitrite by ingoing levels to 500 ppm for nitrate and 200 ppm for limiting the nitrite respectively.

(Source: Dr. Ir. P. S. van Roon, University of Utrecht, Faculty of Veterinary Medicine, Department of Meat Technology.)

Hungary

Nitrate is allowed in all meat products, but simul-

1. Is it allowed to use nitrate in your country ?	NORWAY NO	SWEEDEN NO	FRANCE YES	HOLLAND YES	DENMARK YES	FINLAND YES	WEST GERMANY YES	HUNGARY YES
2: In what products is it allowed to use nitrate ?	NONE	NONE	ALL CURED MEAT PRODUCTS	ALL CURED MEAT PRODUCTS	WILTSHIRE BACON SHELF-STABLE CURED MEAT AND DRIED, CURED SAUSAGES	CURED AND SMOKED PRODUCTS, LIVERS AND KIDNEYS	IN ALL MEAT PRODUCTS	IN ALL CURED MEAT PRODUCTS
3: Is pure nitrite allowed in meat products ?	NO	NO	NO	YES	NO	NO	NO	NO
4. In what meat products is pure nitrite allowed?	NONE	NONE	NONE	SOME FACTORIES MAY USE IT IN ALL CURED MEAT PRODUCTS	NONE	NONE	NONE	NONE
5. Is it allowed to use nitrite salt which is salt mixed with pure nitrite in your country ?	YES	YES	YES	YES	YES	YES	YES	YES
6: How many percent nitrite is in your nitrite salt ?	0,5%	0,6%	0,6%	0,6%	0,6%	0,6%	0,5-0,6%	0,5 %
7: In which products is nitrite salt allowed ?	ONLY IN CURED MEAT PRODUCTS INTENDED FOR SLICING, FOR DRIED CURED PRODUCTS AND FOR PASTEURIZED CANNED PRODUCTS	IN ALL CURED MEAT PRODUCTS	IN ALL CURED MEAT PRODUCTS	IN ALL CURED MEAT PRODUCTS	IN ALL CURED MEAT PRODUCTS	IN ALL CURED MEAT PRODUCTS	IN ALL CURED MEAT PRODUCTS	IN ALL CURED MEAT PRODUCTS
8: What amounts of nitrite salt are allowed to add in the products ?	See No.10.	See No.10	See No.10	NO LIMIT	See No.10	See No.10.	No limit	No limit
9: Is there any maximum limit to the addition of nitrate in meat products ?	0 ppm	0 ppm	200,500 ppm and 1000 ppm	NONE	NONE	NONE	600 ppm KNO_3 and 500 ppm $NaNO_3$	NONE
10: Is there a maximum limit for addition of pure nitrite or nitrite salt ?	60 ppm and 200 ppm	200 ppm	120 ppm	None, but 200 ppm proposed	175 ppm	NONE	NONE	NONE
11: Is there a maximum limit to the "restnitrate"?	NO LIMIT	NO LIMIT	NO LIMIT	NO LIMIT	500 ppm	50 ppm	NO LIMIT	2000 ppm $NO_3 + NO_2$ together
12: Is there a maximum limit to the "restnitrite"?	NO LIMIT	NO LIMIT	NO LIMIT	NO LIMIT	75 ppm and 25 ppm	15 ppm	200 ppm (inofficial)	150 ppm
13: Do you have any opinion in what direction the authorities in your country intend to "go" if it comes to a ban or limitations in the use of nitrate and nitrite ?	NO CHANGES EXPECTED	NO CHANGES EXPECTED. IF ANY, FUTURE U.S. REGULATIONS WILL BE USED	NO CHANGES EXPECTED	PROPOSAL ON MAX ADDITION OF 500 ppm NITRATE AND 200 ppm OF NITRITE		PROPOSED MAX RESIDUAL OF NO_3 and NO_2 is 7,5 ppm MAXIMUM ADDITION OF 30 ppm NO_3 and 15 ppm NO_2 100% limit residual $NO_3 + NO_2$	A REDUCTION FROM 0,6% NO_2 TO 0,4-0,5 % NO_2 IN THE NITRITE SALT	NO CHANGES EXPECTED

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taneous use of nitrite is forbidden.

No pure nitrite is allowed in any meat product, but 0.5% nitrite in curing salt is allowed for all cured meat products.

No limitation is made on the addition because of the exclusive use of nitrite salt.

No maximum limit for the addition of nitrate in meat products has been set.

The maximum limit for residual nitrate ($\text{NO}_2 + \text{NO}_3$ together) is 2,000 ppm, and the maximum limit for residual nitrite is 150 ppm.

According to Dr. Toman, director of The Hungarian Meat Research Institute, "We have no information concerning what direction the Hungarian Health Authorities intend to go when it comes to bans or limitations on the use of nitrate and nitrite."

Sweden

Nitrate is allowed in meat products in Sweden. Pure nitrite is not allowed, only nitrite salt containing 0.6% nitrite is allowed in all cured meat products.

The maximum allowed addition of nitrite is 200 ppm and with no maximum limit for residual nitrite.

Swedish health authorities intend basically to give the same regulations as future American regulations on nitrite. Before making any changes, the research

results and new regulations from the United States will be reviewed and considered.

West Germany

Nitrate is allowed in dried cured hams and in dry sausages such as salami. Nitrate cannot be used in combination with any nitrite.

Nitrite is only allowed when mixed with salt containing 0.5-0.6% sodium nitrite. This mixture is allowed in all cured meat products, with no maximum limit. The limitation depends only upon the salt addition.

The maximum limit for residual nitrate in the finished products, but an official limit for residual nitrite is 200 ppm.

In the future a reduction of 20% nitrite in the salt containing today 0.5-0.6% nitrite will be made. This means reduction to 0.4-0.5% sodium nitrite in curing salt.

According to Dr. Leistner at the Bundesanstalt für Fleischforschung, Kulmbach, "It is proposed that nitrate shall in the future only be allowed in raw hams in the same amount as allowed today, until more information is available. The most important reason for food poisoning from meat products has been *Clostridium Botulinum* in raw cured ham with bone in."