CODEX ALIMENTARIUS COMMISSION

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World Health Organization

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Agenda Item 5(c) **CX/FA 19/51/9**
March 2019

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD ADDITIVES

Fifty-first Session

DISCUSSION PAPER ON THE USE OF NITRATES (INS 251, 252) AND NITRITES (INS 249, 250)

Prepared by an Electronic Working Group (EWG) chaired by the European Union and the Netherlands

whose members included Australia, Austria, Brazil, Canada, Columbia, Ecuador, Egypt, European Union, France, India, Indonesia, Iran, Ireland, Japan, Kazakhstan, Malaysia, Mexico, the Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Peru, Poland, Romania, Russian Federation, Sweden, Switzerland, Turkey, United Kingdom, United States of America, Uruguay, Vietnam, FoodDrinkEurope (FDE) and International Dairy Federation (IDF)

Background

1. The provisions for nitrates (INS 251, 252) and nitrites (INS 249, 250) were included in the paper CX/FA 16/48/7 for discussion at CCFA48. During the Physical Working Group (PWG) meeting held prior to the CCFA48 concerns were raised as to the expression of the maximum use levels for nitrates and nitrites as ingoing amount and/or residual amount, the appropriate maximum use levels, and safety of their use. After consideration of this issue, the PWG agreed to the proposal that the European Union (EU) drafts terms of reference for a discussion paper on this issue. As such, with the exception of provisions for nitrites in food categories 01.6.1 (Unripened cheese) and 01.6.2 (Ripened cheese) which were recommended for discontinuation, the PWG agreed to hold all provisions for nitrates and nitrites, pending the outcome of the consideration of the draft terms of reference for this discussion paper (CRD 2, CCFA48).

2. The issue was further discussed at CCFA48 where the JECFA Secretariat clarified that the basis for the ADI was on toxicological considerations of the nitrates and nitrites as such and that while nitrosamine formation was considered, it did not form the basis for the ADI. The formation of nitrosamines in the body or in foods was well known and could occur also from nitrates and nitrites occurring naturally in food and not only from their use as food additives. Therefore, nitrates and nitrites when used as food additives should be used at the minimum levels needed to achieve the functional purpose. Risk / benefit consideration were important because the use of nitrates and nitrites as a preservative was intended to improve the microbiological safety of the product (REP16/FA, para. 60). Reflecting the discussion, CCFA48 agreed that the Netherlands would prepare a discussion paper with inputs from the JECFA Secretariat identifying concerns for the food additive use of nitrates (INS 251, 252) and nitrites (INS 249, 250) for consideration at CCFA49.

3. At CCFA49 the Netherlands introduced the discussion paper (CX/FA 17/49/11) and explained the three main concerns identified, i.e. expression of maximum use levels as ingoing and/or residual amounts; the technological need that reflects the benefits and risks; and appropriate use levels that take into account the ADI. The CCFA Chairperson, noted that the paper covered matters related both to risk management and risk assessment and proposed to focus the discussion on how best to refine the paper to facilitate future work of both CCFA and JECFA. CCFA49 noted the views as regards potential health concerns related to nitrates and nitrites including risks from the consumption of vegetables, the need for further scientific inputs in a number of areas, the fact that the recommendations covered roles of both JECFA and CCFA and that they should be further elaborated to clearly define the questions to be addressed by risk management and those to be considered through an appropriate risk assessment mechanisms and agreed to establish an EWG chaired by the European Union and co-chaired by the Netherlands to continue working on this matter (REP17/FA, paras. 103-106).

4. At CCFA50 the EU introduced the discussion paper (CX/FA 18/50/9) that analysed concerns identified, suggested an approach for issues to be addressed by the Committee and refined the scope of questions for which scientific advice may be required. It was noted that the further alternative proposals on the next steps were outlined by the JECFA secretariat in CRD6. The JECFA Secretariat expressed the view that some questions raised in the discussion paper would benefit from additional data and encouraged the Committee to consider gathering further relevant data on members' existing risk-management processes and risk assessment performed by competent authorities, so as to enable the Committee to take an informed decision

at its next session as to the most effective use of any possible risk-management options and identify any need to request further scientific advice (REP18/FA, paras. 94 and 96).

Mandate of the EWG

5. In the light of the above discussion CCFA50 agreed to establish an EWG, chaired by the European Union and co-chaired by the Netherlands, and working in English only with the following Terms of Reference:

Develop an inventory of data available on nitrates and nitrites, taking into account document CX/FA 18/50/9 and the comments of the joint FAO/WHO JECFA Secretariat contained in CCFA50/CRD6, with a view to consulting with JECFA and CCFA regarding next steps, in particular by:

(i) collecting general information on risk-management approaches on nitrates and nitrites used as food additives by regulatory agencies of Codex members;

(ii) collecting information on Q1 as outlined in CX/FA 18/50/9;

(iii) collecting, using the table outlined in Recommendation 4 of CX/FA 18/50/9, information on Q2 for each of the GSFA subcategories for which provisions on nitrates and nitrites existed (whether adopted or in the Codex Step procedure), and, when available, providing accompanying data and studies demonstrating the effectiveness of the levels in performing the desired technological function;

(iv) collecting information on natural occurrence data on nitrates and nitrites; and

(v) collecting available information on QI-QV to further consider feasibility and the need for risk assessment.

Addressing the mandate of the EWG

6. The aim of the work was to collect information from Codex Members and Observers on the items (i) to (v) of the mandate. The information received should be available to the Committee in order to take an informed decision for the next steps. This final paper describes the data collection process and summarises the information received.

Data collection process

7. The EWG worked through the Codex EWG Online Platform[1]. The circular paper was distributed to the participants via the email and it was uploaded to the online platform user group “EWG on nitrates and nitrites”. The paper included five annexes corresponding to points (i) to (v) of the mandate and it provided for the templates for the replies. The replies were received from Brazil, Indonesia, Japan, Mexico, Nicaragua, Peru, Sweden, Switzerland, Uruguay, United States of America, FoodDrinkEurope and International Dairy Federation. A specific call was put on the FAO/WHO websites[2] and circulated as usual through Codex to collect data on natural occurrence of nitrates and nitrites.

Summary of the information received

Annex 1 - General information on risk-management approaches on nitrates and nitrites used as food additives by regulatory agencies of Codex members

8. The EWG members were requested to describe the risk management approach taken and the rationale behind it (e.g. how the regulatory limits were established; are the MLs expressed as ingoing amount/residual amount or in other way – what was the reason to express them like that; how the compliance is checked/monitored/ensured, other measures like MLs on nitrosamines in products; co-authorisation of other food additives in conjunction with nitrites and nitrates to inhibit nitrosamine formation etc.).

9. The feedback received outlined different risk management approaches among the Codex members. Several EWG members referred to the MLs established as a residual amount and/or checking the residual amounts in the final products while some other EWG members referred to an approach based on the ingoing amounts. One EWG member explained its risk management approach covering both the premarket evaluation, to ensure that the products meet the MLs for the formulation (i.e. ingoing amounts) and in the final products (i.e. certificate of analysis of residual amounts), and the post market evaluation by sampling the products available on the market.

[1] http://forum.codex-alimentarius.net/
[2] http://www.fao.org/food/food-safety-quality/scientific-advice/calls-data-experts/en/ and https://www.who.int/foodsafety/call-data/en/

10. As regards advantages of the residual MLs the EWG members explained that:

(i) only the residual limits enable the compliance inspection of the products at any point in the food chain (i.e. at the end of the production process, for the products available for sale on the market and when the products are imported);

(ii) setting residual MLs is more appropriate to manage intake of nitrites and nitrites used as food additives since residual concentrations of nitrites decrease during storage but their concentration may increase when nitrates are used (due to reduction reactions to nitrites) and because both nitrates and nitrites may be present in foods as a result of contamination of agricultural products;

(iii) competent authorities check the compliance with the maximum residual levels. The EWG members referred to specific procedures or analytical methods such as "a standard for the sampling of the product to monitor the level of nitrates and nitrites as residual amount" or to the specific ISO and NMKL standards dealing with the determination of nitrates/nitrites in foods (ISO 2918, ISO 3091, NMKL 165 and NMKL 194).

11. As regards ingoing maximum levels:

(i) one EWG member provided information on the maximum levels in its legislation for added sodium and potassium nitrites/nitrates for the individual food categories. He however clarified that the controls are carried out both in the establishments and at the points of sale by the methods set out in NOM-213-SSA1-2002[3] (i.e. the residual amounts are checked);

(ii) another EWG member provided detailed information on the rational and evolution of its legislation which established the ingoing amounts based on the weight of the meat used in the product formulation. According to this EWG member using finished weight would be unacceptable because more curing agent than is allowed (and needed for meat only) could be added. The limits established vary among the curing methods because the methods differ in the efficiency with which the curing agent is brought into contact with the meat (see the table below). However, despite having the ingoing levels in place, the use of nitrites, nitrates (or a combination of both) must not result in more than 200 mg/kg expressed as sodium nitrite in the finished product. In addition, a minimum ingoing amount of 120 mg/kg (i.e. 80 mg/kg as nitrite ion) is required, based on a review of safety data, in all cured "Keep Refrigerated" products unless the establishment can demonstrate that safety is assured by other preservation process. Whilst there is no regulatory requirement for minimum ingoing nitrite for shelf-stable products, 40 mg/kg (i.e. 25 as nitrite ion) is considered useful for some preserving effect and sufficient for colour-fixing purposes. As regards nitrosamine formation, which according to this EWG member can only take place under special conditions where temperatures reach levels higher than 130 °C, specific measures were taken for bacon. These measures consisted in limiting the maximum ingoing amount of sodium nitrate to 120 mg/kg, banning the use of nitrates that the actual concentrations of nitrites can be controlled more precisely and requiring the use of 550 mg/kg sodium ascorbate or erythorbate to accelerate the chemical conversion of nitrite to nitric oxide, thereby reducing nitrosamine formation.

Table 1: Maximum levels for curing ingredients as provided by one EWG member

Curing agent	**Curing Method (all values expressed as ppm)**			
	Immersion cured	Massaged or pumped	Comminuted	Dry cured
Sodium nitrite	200	200	156	625
Potassium nitrite	200	200	156	625
Sodium nitrate	700	700	1718	2187
Potassium nitrate	700	700	1718	2187

12. Some EWG members informed that their legislation is based on the Codex Alimentarius standards (i.e. GSFA) and/or takes into account the provisions established by the EU or the US FDA.

Annex 2 - Views on the most appropriate way of expressing the MLs in relation to control purposes, international trade and different production processes

13. The comments received indicated diverging views of the EWG members. While certain EWG members were clearly in favour of the MLs expressed as ingoing and others as residual, some other EWG members acknowledged pros and cons of both.

[3] Available at https://www.dof.gob.mx/nota_detalle.php?codigo=5508581&fecha=21/12/2017

14. The arguments in favour of the MLs expressed as ingoing amounts included:

(i) the adoption of the "ingoing" approach is advantageous in terms of microbiological safety[4] because products vary in process, pH, water activity, packaging, etc., which hinders (but does not prevent) the establishment of residual levels;

(ii) nitrates and nitrites react with food matrix during food processing and change into other compounds such as nitrosomyoglobin and nitrosamines; ingoing amounts indicate the real quantity added;

(iii) ingoing amounts allow to base the level for curing agents on the weight of meat in the formulation. Using finish weight is not acceptable as more curing agent could be added;

(iv) expressing MLs as residual amounts for control purposes is not an efficient approach to ensure public health or international trade as there are not sufficient resources to routinely test residual levels;

(v) it is unclear how testing methods for detecting residual levels can be standardised for the various matrices making it impractical to establish MLs based on residual levels;

(vi) providing guidance on the ingoing amount better fits the need of protecting public health and would facilitate international trade by ensuring that anyone following the standards does not exceed the established ML.

15. The arguments in favour of the MLs expressed as residual amounts included:

(i) ingoing approach makes it difficult to control the products available on the international market as controls would only be possible at the producing establishments, whilst residual levels can be checked at any point in the food chain. An auditable methodology should be provided for if the levels are expressed as ingoing;

(ii) residual levels are more relevant for judging the amounts ingested by the consumer and thus for the exposure assessment;

(iii) many countries take up the reference of the GSFA, therefore, it is necessary to specify harmonised maximum levels in terms of residual quantity, for different types of products and guarantee protection to the health of the consumer;

(iv) provided that the MLs include all dietary sources of nitrates and nitrites they should be based on a residual content to restrict both added as well as naturally occurring nitrates and nitrites to simplify the international trade.

16. The EWG members also made comments and suggestions on the most appropriate way of expressing the MLs. It included the following options:

(i) ingoing amounts;

(ii) ingoing amounts related to the weight of the meat in the formulation of the product;

(iii) residual amounts;

(iv) residual amounts with minimum and maximum limits (to ensure effectiveness in relation to *C. botulinum* and the protection of human health against toxicological risk) and adopting an approach of concomitant use with other additives in order to reduce the formation of nitrosamines;

(v) residual amounts covering all dietary sources (i.e. naturally occurring and added as food additives).

Annex 3 – Collecting information on the uses and use levels of nitrates and nitrites as food additives

17. The intention of Annex 3 of the circular paper was to collect information on the uses and use levels (ingoing and residual, minimum, typical and maximum) for products in each of the GSFA (sub)categories for which there are adopted, draft or proposed draft provisions for nitrates and nitrites. In addition, it was requested to provide, when available, data and studies demonstrating the effectiveness of the levels in performing the desired technological function, information on the alternatives to nitrates and nitrites and information on the use of other additives intending to inhibit the formation of nitrosamines.

[4] EFSA Journal (2003) 14, 1-31, The effects of Nitrites/Nitrates on the Microbiological Safety of Meat Products.

18. Compilation of the information received is provided in tables 2 and 3 of Appendix 1 to this paper. Only the food categories for which some information was provided were kept in the tables. Data (use levels) were kept as received from the EWG members. As the use levels are expressed differently in different countries the numbers provided are not directly comparable. The chairs added one additional column to the table ('Note') which should clarify, to the best of their knowledge and based on the information provided by the EWG members, on what basis are the reported use levels expressed. Use levels need to be converted to NO2 ion for nitrites and NO3 ion for nitrates for consideration of the MLs or for the exposure estimates.

19. In addition, in case of ingoing amounts one EWG member clarified that the use levels are related to the weight of the meat in the formulation of the product. In absence of similar comments made by the other EWG members, the chairs assume that other reported ingoing as well as residual levels are related to the product as marketed/consumed. The point in time to which the reported residual levels relates was not provided except by one EWG member that referred to the levels of residual amount within 3 days after the end of the production process. Those aspects are captured in the tables.

20. The reported use levels were generally related to the whole (sub)-categories but in some cases they were limited to certain specific products (e.g. bacon, dried cured ham, beef jerkey).

21. Except for the use of nitrates in ripened cheese, no references to studies demonstrating effectiveness of the reported use levels were given.

22. For the vast majority of the uses the EWG members indicated a 'preservative' or both a 'preservative and a colour retention agent' as the appropriate functional class, except for the use of nitrites in the category 09.3.3 'Salmon substitutes, caviar and other fish roe products' for which the functional class 'colour retention agent' was indicated.

23. Possible alternatives to nitrates and nitrites were outlined only for the use of nitrates in ripened cheese (bactofuge or microfiltration to remove clostridia) and processed cheese (other preservatives) but not for any other food category.

24. A possible use of ascorbic acid/sodium ascorbate/erythorbic acid/sodium erythorbate (or tocopherols) together with nitrates or nitrites with the intention to inhibit nitrosamines' formation was indicated for the vast majority of the uses. One EWG referred to a legislative requirement for the use of 550 mg/kg of sodium ascorbate or erythorbate to prevent nitrosamine formation.

25. According to one EWG member, the use of nitrates in cheese production is a processing aid use. According to another EWG, that reported residual amounts of nitrates in cheese, the biological process results in the absence of residues of nitrates or nitrites in the final cheese mass.

Annex 4 – Collecting information on natural occurrence data on nitrates and nitrites

26. The EWG chairs and FAO/WHO invited all interested Codex members and observers to submit monitoring data on natural occurrence of nitrates and nitrites in food, including drinking water. Natural occurrence was understood to be the presence of nitrate and nitrite in food not related to the use of nitrate and/or nitrite as food additives.

27. Data were submitted by Australia (36 entries for nitrites and 36 for nitrates), the European Union[5] (3152 for nitrites and 27427 for nitrates), Indonesia (37 for nitrites and 37 for nitrates), Ireland (768 for nitrates) and Japan (150 for nitrites and 150 for nitrates). The data are available in the GEMS online database[6] for further use by the Committee.

Annex 5 – Available information on questions QI-QV to further consider feasibility and the need for risk assessment

28. The intention of Annex 5 was to collect available information on QI-QV of CX/FA 18/50/9 to further consider feasibility and the need for risk assessment. The questions and feedback received is outlined below.

> *QI What expression of the MLs (i.e. as ingoing or residual or both) is supported by the available data, taking into account the relationship between ingoing and residual amounts, in relation to the protection of human health, i.e. inhibitory effect on bacteria (especially Cl. botulinum), nitrosamines formation in all routes and ADI?*

[5] The data also included foods to which nitrites and nitrates were added as food additives
[6] The Global Environment Monitoring System available at https://www.who.int/foodsafety/areas_work/chemical-risks/gems-food/en/

29. The feedback received from the EWG members on QI:

(i) for microbiological control of *C. botulinum,* the "ingoing" approach is advantageous, though “residual” approach may also be effective. However, for the refined risk exposure, the residual amount approach is more adequate, since it considers the content of nitrite and nitrate that will in fact be ingested by the consumer;

(ii) MLs for nitrites and nitrates are expressed as residual amount of nitrite ion for meat products and fish roe products. For use as fermentation aids for cheese and sake (rice wine), MLs for nitrates are expressed as ingoing amount per amount of raw materials. The intake of nitrates and nitrites used as food additives is estimated from poundage data and confirmed to be less than ADI evaluated by JECFA;

(iii) the MLs should be expressed as the ingoing amount. Calculations for curing agents should be based on the weight of the meat in the formulation of the product. Because nitrite and nitrate, after being converted to nitric oxide, function by reacting chemically with the meat or poultry myoglobin, the amounts of nitrite or nitrate permitted in the cure must be based on the meat block used in the formulation, not the finished weight of the product. Using finished weight as the weight base for these calculations would be unacceptable because more curing agent than is allowed could be added to the product.

QII Does exposure to nitrites and nitrates pose a health risk? What are recent exposures from all sources and from food additive uses? What is the relative contribution of dietary exposure from food additive uses relative to exposure from other sources (fruits, vegetables and drinking water)?

30. The feedback received from the EWG members on QII:

(i) in Brazil, according to a study performed by Pedroso (1993) which evaluated the consumption of nitrites and nitrates present in meals served in restaurants, the estimated intake of nitrate and nitrite was 3.3 mg/kg body weight and 0.02 mg/kg body weight, respectively. In another study carried out with students from the city of São Paulo, it was concluded that the intake of nitrites and nitrates from the daily diet does not represent a public health concern in that population (Torres et al., 2001). In addition, a study was carried out to determine nitrate content in leafy vegetables through different production systems. The levels can be found in Table 1 of the study (Guadagnin et al., 2007) and ranged from 115 mg/kg for lettuce to 9703 mg/kg for hydroponically grown aragula;

(ii) in Japan, a market basket study conducted in 1999 estimated exposures to nitrites and nitrates from all sources[7]. Exposures to nitrites and nitrates were 0.339 mg/person/day and 289 mg/person/day, respectively. Nitrites were detected from roots and legumes, and most of nitrates were taken from vegetables and fruits (284 mg/person/day). For nitrates, similar results were obtained in 2008 (Matsuda et al., 2009). Exposures from food additive uses estimated from poundage data in Japan (Sato et al., 2016) were as follows: 0.308 mg/person/day for sodium nitrite (as NO2-), 0.021 mg/person/day potassium nitrate (as NO3-) and 0.004 mg/person/day sodium nitrate (as NO3-). Intake of nitrates from all sources exceeded the ADI, though the intake from food additives was little. Most of nitrates are derived from vegetables and the intake of nitrates from this source was considered to be acceptable, taking into account the important role of vegetables in a healthy diet;

(iii) in Switzerland, an exposure assessment based on Swiss consumption data of processed meat is not available. Oral exposure of nitrite/nitrate/nitrosamines/processed meat is linked to mainly colorectal (and gastric cancer) in humans based on epidemiologic studies as recently evaluated by EFSA (2017a,b) and IARC (2018). The potential formation of nitrosamines from nitrite should be minimised, as some nitrosamines are potent genotoxic and carcinogenic substances with a known direct DNA-reactive mechanism. This needs to be considered seriously in risk-benefit assessments and considerations of avoidable/unavoidable other sources of exposure;

[7] Ministry of Health and Welfare (2000) Market basket study on daily intake of food additives. https://www.ffcr.or.jp/houdou/2001/01/CE7101D177B43F05492569DF000BA6E6.html

(iv) the US summarised the JECFA safety assessments for nitrites and nitrates and described how the ADIs were derived. A reference was made to the JECFA's forty-fourth meeting (1995) which concluded that nitrate was not genotoxic, that the carcinogenicity studies with nitrite were negative except when extremely high doses of nitrite and nitrosatable precursors were administered, and that the available epidemiological data were considered to provide no evidence for an association between exposure of humans to nitrite and the risk for cancer. The US provided an overview of several studies showing that exogenous sources for human intake of nitrates are primarily derived from plant derived foods (vegetables 80-90%) and drinking water (14%). For nitrites it was explained that humans generally consume 1.2-3.0 mg of nitrite per day of which saliva accounts for approx. 93% and cured meats have been reported to comprise 4.8% and vegetables 2.2%. Before modern meat curing processes were adjusted the proportion of ingested nitrite from cured meats was higher (39%).

QIII Does exposure to nitrosamines (exogenous and endogenous) pose a health risk? What are recent exposures from all sources and from food additives to nitrosamines generated during: i) the production process in foods; ii) heat-treatment in the domestic setting; and iii) gastrointestinal transit?

31. The feedback received from the EWG members on QIII:

(i) one EWG member referred to a study carried out by Toyohara (1989), which evaluated the levels of N-nitrosamines in commercial sausages, a content of 97.5 ± 59.1 µg/kg of N-nitrosodimethylamine (NDMA) and 43.1 ± 37.9 µg/kg of nitrosopyrrolidine (NPYR), values 10 times higher than those found in the literature were reported. According to Dutra (2006), which evaluated the nitrosamines content in hot dog sausages, nitrosamines were not detected in the analysed samples, possibly because of the action of sodium ascorbate that acts as an inhibitor in the formation of nitrosamines. The same study presents in its Tables 1, 2, 3, 4 and 5 the levels of nitrosamines found in meat products, milks and derivatives, fish and seafood and other foods;

(ii) another EWG member referred to an IARC monograph (IARC, 2006) which concluded that ingested nitrate or nitrite under conditions resulting in endogenous nitrosation is probably carcinogenic to humans. However, this EWG member pointed out that there were question marks on the appropriateness of the IARC conclusion. In particular, this member highlighted that, according to the IARC conclusion, swallowing saliva in combination with any food could be considered to result in a potential formation of nitrosated compounds since most of the ingested nitrite is formed in saliva. A reference was made to the JECFA's evaluation (1995) which took into consideration the safety of the additives, including exposure to nitrosamines and which did not lead to a change of the ADI.

QIV What are appropriate levels (ingoing and residual) necessary to inhibit Cl. botulinum in view of risk (nitrosamines, ADI being exceeded) and benefit (microbiological safety) considerations taking into account other factors affecting microbial growth?

32. The feedback received from the EWG members on QIV:

(i) one EWG member referred to the EFSA opinion (2003) which clarified that 50-100 mg/kg of added nitrite as sodium nitrite in meat products seems to be sufficient for several products, however, in other products, especially those with low salt content and long shelf life, the addition of 50-150 mg/ kg nitrite is required to inhibit the growth of *C. botulinum*;

(ii) another EWG member was of the view that 200 mg/kg as sodium nitrite or more is needed for non-heat-treated process meat to inhibit microbial growth and pointed out that the exposure estimates to nitrites and nitrates as food additives, based on the poundage data, do not exceed the ADIs;

(iii) another EWG member referred to the minimum required level of 120 mg/kg of ingoing nitrite (as sodium nitrite), established on safety data reviewed, to control the development of *C. botulinum* in all cured "Keep Refrigerated" products.

QV To what extent does the use of additives such as ascorbic acid in conjunction with nitrates and nitrites reduce nitrosamine formation and mitigate the potential health risk from the use of nitrates and nitrites? Is available information sufficient to allow the safe use of nitrates and nitrates at higher levels when used in conjunction with these additional additives?

33. The feedback received from the EWG members on QV:

(i) one EWG member informed on the use of sodium ascorbate, sodium erythorbate and nicotinamide in ham, pressed ham, sausage, bacon and corned beef ranging between 200-500 mg/kg and of sodium ascorbate in fish roe products (tarako) at 19.000 mg/kg in pickling solution;

(ii) another EWG member explained that since 1975 it has accepted that ascorbic acid retards, but does not totally eliminate, the formation of nitrosamine. According to this EWG member data available at that time indicated the nitrosamine problem for bacon and not for other cooked products. Thus, for bacon the level of 120 mg/kg of nitrite with 550 mg/kg of ascorbate or erythorbate has been enforced. Another combination (40 mg/kg of nitrite and 0.26% potassium sorbate) provided protection against botulism and resulted in less nitrosamine formation. However, the use of potassium sorbate caused allergic reactions and several reactive products formed by the combination of sorbate and nitrite at low pH and high temperatures were found to be mutagenic. According to this EWG member, to date no ingredient has been identified that effectively reproduces all the important properties of nitrites.

Concluding remarks

34. The information collected indicates different risk management approaches and different views on the most appropriate way of expressing the use levels for nitrates and nitrites (ingoing/residual/expressed on the final product/related to the meat content in the formulation/minimum/maximum).

35. Significant differences can be observed between both ingoing and residual use levels reported by the EWG members for the same food categories. No specific studies demonstrating the effectiveness of the reported levels were provided. While the number of the food (sub)-categories for which the EWG members provided information differs, the EWG members indicated a lack of alternatives to the use of nitrates and nitrites. The information on a possible addition of ascorbates/erythorbates with the intention to inhibit nitrosamines formation was indicated for many uses reported.

36. The data on natural occurrence of nitrates and nitrites were collected. It is now up to the Committee to consider whether and how to make use of these data.

37. In providing information on questions QI-QV the EWG members reported exposure estimates situated within the ADIs and exceeding the ADIs (for nitrates from all sources). It was outlined that the main source of exposure is derived from vegetables. However, a concern was raised on the oral exposure of nitrites/nitrates/nitrosamines from processed meat and the link with cancer based on epidemiologic studies and on the amounts on nitrosamines which can be present in commercial products (sausages). As regards appropriate levels for inhibiting *Cl. Botulinum*, the EWG members indicated the minimum levels ranging between 50-200 mg/kg expressed as sodium nitrite.

Recommendations

38. The objective of this work was to create an inventory of the available data to (1) consider the most effective risk management options and (2) identify any need to request further scientific data with a view of consulting with JECFA and CCFA as regards the next steps. The Committee may thus further analyse the information collected and may consider taking specific decisions on the next steps as indicated in Recommendations 1 and 2 below.

Recommendation 1

39. In light of the available information, the Committee is invited to consider and possibly decide on the most appropriate risk management approach on addressing the uses and use levels for nitrates and nitrites in the GSFA. The Committee can take into account the suggestions made by the EWG members as outlined in paragraph 16 of this paper.

Note: In the absence of consensus on a preferred approach, the Committee might consider establishing both ingoing and residual levels as a compromise solution.

Recommendation 2

40. In light of the information available and taking into account the views of JECFA secretariat the Committee should consider whether the provided information addresses the concerns raised or whether further scientific advice is feasible and needed.

Note: If the Committee agrees on the approach (Recommendation 1) and decides that there is no need for further scientific advice (Recommendation 2) it might consider start working on the provisions. If the Committee decides that there is a need for further scientific advice a request for the scientific advice will have to be formulated.

Appendix 1

Collected information on the use of nitrates and nitrites as food additives

Table 2: Information collected on the uses and use levels for nitrites

GSFA FC No	Levels - ingoing / residual						Types of products or production processes	Functional class	Reference to studies demonstrating effectiveness of the reported levels	Are there alternatives to the proposed use of nitrites available?	Are other food additives available which are being used in conjunction with nitrites with the intention to inhibit the formation of nitrosamines?	Note
	Ingoing amount on the total net content of the final product expressed as NO2 ion#			Residual amount on the total net content of the final product expressed as NO2 ion#								
	Min	Typic	Max	Min	Typic	Max						
08.1.1	**Fresh meat, poultry and game, whole pieces or cuts**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
08.1.2	**Fresh meat, poultry and game, comminuted**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
08.2.1.1	**Cured (including salted) non-heat treated processed meat, poultry, and game products in whole pieces or cuts**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
	203	210	218	5*	10*	50*	bacon	Preservative		No	Sodium ascorbate is used with nitrites in bacon in FC 08.2.1.1.	Expressed as NO2
			156					Colour retention agent & preservative			Salts of ascorbic acid, erythorbic acid and tocopherols, the above can be used in combination with nitrites.	Expressed as NO2

						150		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
	120	200	625	0,2	6,8	36,5	bacon (wet and dry cured)	Colour retention agent & preservative		No	USA regulation requires 550 ppm sodium ascorbate or erythorbate be added to bacon to prevent nitrosamine formation	Expressed as NaNO2 or KNO2 based on the weight of the meat in the formulation of the product
08.2.1.2	**Cured (including salted) and dried non-heat treated processed meat, poultry, and game products in whole pieces or cuts**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
	100	277	350	3*	30*	50*	dried cured ham	Preservative		No	Sodium ascorbate is used with nitrites in dried cured ham in FC 08.2.1.2.	Expressed as NO2
	100	247	350	3*	30*	50*	dried cured pork loin	Preservative		No	Sodium ascorbate is used with nitrites in dried cured pork loin in FC 08.2.1.2.	Expressed as NO2
	121	128	142	6*	15*	50*	beef jerkey	Preservative		No	Sodium ascorbate is used with nitrites in beef jerkey in FC 08.2.1.2.	Expressed as NO2
	97	99	100	1*	2*	50*	pork jerkey	Preservative		No	Sodium ascorbate is used with nitrites in pork jerkey in FC 08.2.1.2.	Expressed as NO2
			156					Colour retention agent & preservative			Salts of ascorbic acid, erythorbic acid and tocopherols, the above can be used in combination with nitrites.	Expressed as NO2
						150		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	

		200	625	0,02	1,5	16,2	dry cured country ham, prosciutto	Colour retention agent & preservative		No		Expressed as NaNO2 or KNO2 based on the weight of the meat in the formulation of the product.
08.2.1.3	**Fermented non-heat treated processed meat, poultry, and game products in whole pieces or cuts**											
			156					Colour retention agent & preservative			Salts of ascorbic acid, erythorbic acid and tocopherols, the above can be used in combination with nitrites.	Expressed as NO2
						150		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
08.2.2	**Heat-treated processed meat, poultry, and game products in whole pieces or cuts**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
	10	80	250	1*	30*	50*	cooked cured ham, cooked cured pork loin, cooked bacon	Colour retention agent & preservative		No	Sodium ascorbate is used with nitrites in cooked cured ham, cooked cured pork loin, cooked bacon in FC 08.2.2.	Expressed as NO2
	10	78	150	3*	31*	50*	cooked cured pork shoulder	Colour retention agent & preservative		No	Sodium ascorbate is used with nitrites in cooked cured pork shoulder in FC 08.2.2.	Expressed as NO2
	20	100	250	3*	30*	50*	roasted pork	Colour retention agent & preservative		No	Sodium ascorbate is used with nitrites in roasted pork in FC 08.2.2.	Expressed as NO2
	56	111	226	1 *	16*	50*	beef pastrami	Preservative		No	Sodium ascorbate is used with nitrites in beef pastrami in FC 08.2.2.	Expressed as NO2

			156					Colour retention agent & preservative			Salts of ascorbic acid, erythorbic acid and tocopherols, the above can be used in combination with nitrites.	Expressed as NO2
						150		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
		200	625	0,03	7,5	27,6	smoked and cured ham, cured poultry	Colour retention agent & preservative		No		Expressed as NaNO2 or KNO2 based on the weight of the meat in the formulation of the product.
08.2.3	**Frozen processed meat, poultry and game products in whole pieces or cuts**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
	50	80	90	10*	30*	50*	frozen processed pork products	Preservative		No	No other food additive is used with nitrites in FC 08.2.3.	Expressed as NO2
08.3	**Processed comminuted meat, poultry, and game products**											
						150		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
08.3.1.1	**Cured (including salted) non-heat treated processed comminuted meat, poultry, and game products**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
		223		3*	21*	50*	salami sausages	Preservative		No	Sodium ascorbate is used with nitrites in salami sausages in FC 08.3.1.1.	Expressed as NO2

			156					Colour retention agent & preservative			Salts of ascorbic acid, erythorbic acid and tocopherols, the above can be used in combination with nitrites.	Expressed as NO2
		200	625	0,03	0,8	9,7	salami, chorizo, pepperoni	Colour retention agent & preservative		No		Expressed as NaNO2 or KNO2 based on the weight of the meat in the formulation of the product.
08.3.1.2	**Cured (including salted) and dried non-heat treated processed comminuted meat, poultry, and game products**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
	10	67	135	1*	24*	50*	dried sausages	Colour retention agent & preservative		No	Sodium ascorbate is used with nitrites in dried sausages in FC 08.3.1.2.	Expressed as NO2
			156					Colour retention agent & preservative			Salts of ascorbic acid, erythorbic acid and tocopherols, the above can be used in combination with nitrites.	Expressed as NO2
08.3.1.3	**Fermented non-heat treated processed comminuted meat, poultry, and game products**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
08.3.2	**Heat-treated processed comminuted meat, poultry, and game products**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2

	10	98	200	1*	28*	50*	sausages	Colour retention agent & preservative		No	Sodium ascorbate is used with nitrites in sausages in FC 08.3.2.	Expressed as NO2
	40	81	111	10*	30*	50*	pressed cooked cured pork products	Colour retention agent & preservative		No	Sodium ascorbate is used with nitrites in pressed cooked cured pork products in FC 08.3.2.	Expressed as NO2
	36	78	100	3*	30*	50*	pressed cooked cured chopped pork products	Colour retention agent & preservative		No	Sodium ascorbate is used with nitrites in pressed cooked cured chopped pork products in FC 08.3.2.	Expressed as NO2
			156					Colour retention agent & preservative			Salts of ascorbic acid, erythorbic acid and tocopherols, the above can be used in combination with nitrites.	Expressed as NO2
		156	625	0	7,6	29,3	smoked sausage, frankfurters, jerky	Colour retention agent & preservative		No		Expressed as NaNO2 or KNO2 based on the weight of the meat in the formulation of the product.
08.3.3	**Frozen processed comminuted meat, poultry, and game products**											
						150**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When NO2 and NO3 used together the ML shall not exceed 150 ppm as NaNO2
	50	70	80	10*	30*	50*	frozen sausage	Preservative		No	No other food additive is used with nitrites in FC 08.3.3.	Expressed as NO2
09.2.4.1	**Cooked fish and fish products**											

	50	100	170	2*	2*	33*	specific fish sausages which includes ingredients other than fish, such as cheese and vegetables	Colour retention agent		No	Sodium ascorbate is used with nitrites in fish sausages in FC 09.2.4.1.	Expressed as NO2
			156					Colour retention agent & preservative			Salts of ascorbic acid, erythorbic acid and tocopherols, the above can be used in combination with nitrites.	Expressed as NO2
09.3.3	**Salmon substitutes, caviar and other fish roe products**											
	9	18	30	2*	3*	5*	salted cod roe (*tarako*)	Colour retention agent		No	Sodium ascorbate is used with nitrites in salted cod roe (*tarako*) in FC 09.3.3.	Expressed as NO2
	7		102	1*	2*	4*	salted salmon roe (*sujiko*)	Colour retention agent		No	Sodium ascorbate is used with nitrites in salted salmon roe (*sujiko*) in FC 09.3.3.	Expressed as NO2

Unless otherwise indicated in the column 'Note'
* The levels of residual amount are within 3 days after the end of the production process
** No information on other use levels. However, Brazil has information on detected levels in laboratories and literature
Total net content = i.e. as consumed. It relates to the total weight of the product as available to the consumer (i.e. in case of meat products it is related to the whole weight of the product and not to the meat content)

Table 3: Information collected on the uses and use levels for nitrates

GSFA FC No	**Levels - ingoing / residual**						**Types of products or production processes**	**Functional class**	**Reference to studies demonstrating effectiveness of the reported levels**	**Are there alternatives to the proposed use of nitrates available?**	**Are other food additives available which are being used in conjunction with nitrites with the intention to inhibit the formation of nitrosamines?**	**Note**
	Ingoing amount on the total net content of the final product expressed as NO3 ion#			**Residual amount on the total net content of the final product expressed as NO3 ion#**								
	Min	**Typic**	**Max**	**Min**	**Typic**	**Max**						
01.6.1	**Unripened cheese**											
						50**		Preservative		No		Expressed as NaNO3
01.6.2	**Ripened cheese**											
						50**		Preservative		No		Expressed as NaNO3
			50									

01.6.2.1	**Ripened cheese, includes rind**										
	1200 ***	1200* **	1200* **				Gouda cheese			No	No other food additive is used with nitrates in FC 01.6.2.1.	Expressed as NO2
	100	200	1200* ***	<0,3	30	50	Gouda, Cheddar, Emmental etc. Example of products and levels levels reported: • Edammer 230 mg/L of cheese milk • Semi-soft cheese 1000 mg/L of cheese milk • Ridder 1000 mg/L of cheese milk • Cheese to use for processed cheese 4 % fat 260 mg/L of cheese milk • Cheese to use for processed cheese 16 % fat 720 mg/L of cheese milk • Cheese to use for processed cheese 27 % fat 720 mg/L of cheese milk	Preservative	Prevention of abnormal fermentation of cheese during ripening	Sodium nitrate may be replaced with bactofuge or microfiltration to remove Clostridia with exceptions.		
01.6.4	**Processed cheese**											
										There are other preservative options		
08.1.1	**Fresh meat, poultry and game, whole pieces or cuts**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
08.1.2	**Fresh meat, poultry and game, comminuted**											

						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
08.2.1.1	**Cured (including salted) non-heat treated processed meat, poultry, and game products in whole pieces or cuts**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
	100	100	150	10*	30*	50*	dried cured pork products	Preservative		No	No other food additive is used with nitrates in FC 08.2.1.1.	Expressed as NO2
			156									Expressed as NO2
						300		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
		700	2187	3,5	14	32	bacon (wet and dry cured)	Colour retention agent & preservative		No	USA regulation requires 550 ppm sodium ascorbate or erythorbate be added to bacon to prevent nitrosamine formation	Expressed as NaNO3 or KNO3 based on the weight of the meat in the formulation of the product
08.2.1.2	**Cured (including salted) and dried non-heat treated processed meat, poultry, and game products in whole pieces or cuts**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
			156									Expressed as NO2
						300		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	

		700	2187	0,4	106	1366	dry cured country ham, prosciutto	Colour retention agent & preservative		No		Expressed as NaNO3 or KNO3 based on the weight of the meat in the formulation of the product
08.2.1.3	**Fermented non-heat treated processed meat, poultry, and game products in whole pieces or cuts**											
			156									Expressed as NO2
						300		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
08.2.2	**Heat-treated processed meat, poultry, and game products in whole pieces or cuts**											
						300**		Preservative		No	Some industries use ascobartes in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
		107			9*	50*	cooked cured pork loin	Preservative		No	Sodium ascorbate is used with nitrates in FC 08.2.2.	Expressed as NO2
		111		7*	9*	50*	cooked cured ham	Preservative		No	Sodium ascorbate is used with nitrates in FC 08.2.2.	Expressed as NO2
			156									Expressed as NO2
						300		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
		700	2187	0,2	16	108	smoked and cured ham, cured poultry	Colour retention agent & preservative		No		Expressed as NaNO3 or KNO3 based on the weight of the meat in the formulation of the product
08.2.3	**Frozen processed meat, poultry and game products in whole pieces or cuts**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to	Expressed as NaNO2. When nitrites and nitrates used together the

											prevent nitrosamine formation.	amount shall not exceed 150 ppm
08.3.1.1	**Cured (including salted) non-heat treated processed comminuted meat, poultry, and game products**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
			156									Expressed as NO2
						300		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
		1787	2187	0,1	113	2289	salami, chorizo, pepperoni	Colour retention agent & preservative		No		Expressed as NaNO3 or KNO3 based on the weight of the meat in the formulation of the product
08.3.1.2	**Cured (including salted) and dried non-heat treated processed comminuted meat, poultry, and game products**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
			156									Expressed as NO2
						300		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
08.3.1.3	**Fermented non-heat treated processed comminuted meat, poultry, and game products**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm

						300		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
08.3.2	**Heat-treated processed comminuted meat, poultry, and game products**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
			156									Expressed as NO2
						300		Colour retention agent & preservative		No	Ascorbic acid and sodium erythorbate is used to help the degradation of nitrate to nitrite	
		1787	2187	0,8	46	541	smoked sausage, frankfurters, jerky	Colour retention agent & preservative		No		Expressed as NaNO3 or KNO3 based on the weight of the meat in the formulation of the product
08.3.3	**Frozen processed comminuted meat, poultry, and game products**											
						300**		Preservative		No	Some industries use ascorbates in conjunction with nitrates and nitrites to prevent nitrosamine formation.	Expressed as NaNO2. When nitrites and nitrates used together the amount shall not exceed 150 ppm
		13			<5*		frozen salami sausages	Preservative		No	No other food additive is used with nitrates in FC 08.2.1.1.	Expressed as NO2

Unless otherwise indicated in the column 'Note'
* The levels of residual amount are within 3 days after the end of the production process
** No information on other use levels. However, Brazil has information on detected levels in laboratories and literature
*** Japan submitted the use level of nitrates in ripened cheese just for reference to contribute the discussion. According to Japan nitrates are used as processing aids and they do not serve any technological functions in the final product
**** Amount of NO3 ion added to milk used for producing 1kg of the final product (cheese); according to IDF some literature indicates that 1200 mg/kg of added NO3 corresponds to the residual amount of 20 mg/kg; IDF informed that the biological process results in no residues of nitrates nor nitrites in the final cheese mass

Appendix 2

References provided by the EWG members

Annex 1 – Risk management approaches of the Codex members

ISO 2918

ISO 3091

NMKL 165

NMKL 194

NOM-213-SSA1-2002

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Annex 2 – Most appropriate way of expressing the MLs as regards control, trade and production processes

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