



Australian Government
**Department of Agriculture
and Water Resources**

Carbon monoxide in fish

Pilot survey

Compliance Policy Branch

March 2018



Executive summary

Since 2006, the Department of Agriculture and Water Resources has received a number of complaints from industry alleging that imports of tuna are being treated with carbon monoxide (CO) to fix or alter the colour of the fish flesh. Tuna is treated with CO by either being subjected to a smoking process using a filtered, odourless, tasteless smoke or by gas flushing with CO during processing. The complainants claim that treating tuna with CO directly, or indirectly using filtered smoke, provides the potential for consumer deception by hiding the age and condition of fish. There is also a concern that because the fish will appear fresher than it is, even if temperature abuse occurs, there is the potential for high levels of the toxin, histamine, to develop.

Standard 1.3.3 – Processing aids, in the Australia New Zealand Food Standards Code (the Code), prohibits the use of CO in the processing of fish where its use results in a change to or fixes the colour of the flesh of the fish. This prohibition does not extend to CO that is naturally present or naturally occurring in smoke used in the processing of fish. The Code permits smoking as a traditional ingredient in foods. However, to comply with product identification requirements in the Code, tuna that has been treated with a filtered, odourless, tasteless smoke must be labelled to indicate the product has been ‘smoked’.

To ascertain if there is any evidence that imports of tuna are being treated with CO and also if levels of CO in tuna can be measured when the tuna has been treated directly with CO or indirectly with filtered smoke, the department undertook a small targeted pilot survey to measure the level of CO present. Seventeen samples were taken between May and July 2017 from retail outlets in Melbourne and Sydney where suspected CO treated tuna was being sold. The samples were purchased anonymously and no information was available on whether the samples had been treated with CO or imported. Two control samples were also taken, one known not to have been treated with CO and one known to have been treated with filtered smoke. To assess if the level of CO in tuna had any correlation with histamine levels, all samples were also tested for histamine.

The survey found that all samples tested contained a CO level higher than those expected to be present naturally in fish and fourteen of the seventeen samples had levels above 200 µg/kg, which is the current regulatory limit in the European Union and Japan. These results suggest the tuna were likely to have been treated with CO directly or indirectly via a filtered smoking process. The testing methodology was able to measure CO levels in tuna, whether the CO was present from being gas flushed or having being treated with a filtered smoke. No correlation was found between high levels of CO and histamine levels, with all samples recording levels of <10 mg/kg of histamine.

This small targeted survey indicates that there is tuna in the marketplace that has been treated with CO, some of which may be imported. As there are restrictions in the Code on the use of CO, it is recommended that imported tuna referred for inspection and analysis under the IFIS be inspected and analysed to assess compliance as follows:

- tuna fillets, where there is no documentation or labelling indicating the product has been treated directly or indirectly with CO, are tested for levels of CO and failed if levels exceed 200 µg/kg
- tuna fillets, labelled as having being treated with a filtered, odourless or tasteless smoke in the ingredient list, be failed unless the product is clearly identified as having being 'smoked'
- tuna fillet, labelling as having being treated with CO, be failed.

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1 Introduction

1.1 Background

1.1.1 Use of carbon monoxide to fix or alter the colour of fish flesh

Treatment of high value red-fleshed fish with carbon monoxide (CO), including smoking processes, is a well-known and used process in parts of the world (FSANZ 2013), as it irreversibly fixes or alters the colour of fish flesh, giving it a 'fresh' pink appearance. This provides the potential for consumer deception by hiding the age and condition of fish (Kristinsson et al. 2003), and also raises concern that because the fish will appear fresher than it is, even if temperature abuse occurs, there is the potential for high levels of the toxin, histamine, to develop.

The use of 'filtered smoke' to treat fish has increased in recent years. In comparison to a conventional smoking process, filtered smoke fixes the colour of the fish flesh, but does not impart the flavour or odour as these are stripped from the 'smoke' with the resulting gas used to process the fish (Pivarnik et al. 2011).

1.1.2 Industry complaints

Since 2006, the Department has received a number of complaints from industry expressing concern for imports of tuna that have been subjected to CO treatment to fix the colour of the flesh, potentially misleading consumers by masking the age and condition of fish.

The department has also received a complaint from an industry participant regarding the use of filtered smoke. The complainant asserted that filtered smoking is not a traditional smoking process and is more similar to CO treatment, as the smoke is not used to process the fish. In their view this product is not compliant with the Code and it unfairly competes with other premium products that maintain the colour due to rapid freezing and being maintained at a very low temperature.

Other industry participants have raised complaints that they want a level playing field for filtered smoke and CO treated product – it is all either compliant or non-compliant.

1.2 Regulatory requirements

1.2.1 Australian requirements

In October 2013, Food Standards Australia New Zealand (FSANZ) published the Approval Report for Proposal P1019, Carbon Monoxide as a Processing Aid for Fish (FSANZ 2013). Standard 1.3.3 of the Code was subsequently amended to clarify that CO must not be used in processing of fish where its use results in a change to or fixes the colour of the flesh. This prohibition does not extend to CO that is naturally occurring or present in smoke being used to process fish. Smoking of fish is exempted as it is an established process to impart flavour, odour and colour to fish and other products.

Proposal P1019 did not offer any view on compliance of filtered smoke use, except to advise that smoking is a permitted process for fish, and acknowledged that Standard 1.2.2 requires that labelling for the name of a food is required to be sufficient to indicate the true nature of the food. This includes whether the food has been smoked.

Schedule 19 – Maximum levels of contaminants and natural toxicants, of the Code specifies the maximum level of histamine in fish and fish products as 200 mg/kg.

State and territory food legislation and consumer law, include offences for selling unsafe and unsuitable food, selling falsely prescribed food and engaging in misleading conduct relating to the sale of food.

In addition, the *Imported Food Control Act 1992 (IFC Act 1992)* has offences in relation to knowingly importing food that poses a risk to human health or food that does not comply with the Code. To monitor compliance with Australia's imported food requirements, the department operates a risk based border inspection scheme, the Imported Food Inspection Scheme (IFIS), under the *IFC Act 1992*.

1.2.2 International standards

Filtered smoke is currently not recognised by Codex Alimentarius as a smoking process to treat fish, as the end product does not have smoked sensory characteristics (Codex 2013).

In the US it is permitted to treat fish with filtered smoke (Acheson 2007). However, the ingredient label must indicate that the tuna is treated with filtered smoke, and that it is a preservative. In addition, the tuna may not be represented as 'smoked' or 'fresh'.

It is currently prohibited to treat fish with CO gas in a number of other countries/regions including Singapore, Canada, the European Union (EU), Japan and Taiwan (FSANZ 2013; Schubring 2008).

The EU and Japan have a regulatory action level of 200 µg/kg, above which fish would be considered non-compliant for treatment with CO (Feldhusen, Rehbein & Kruse 2004).

2 The survey

2.1 Aim of the survey

The aims of the pilot survey were to determine if:

- there is evidence that imports of tuna are being treated with CO either as a result of the tuna being gas flushed with CO or filtered smoke
- tuna that has been gas flushed with CO or filtered smoke contain levels of histamine greater than the legal limit in the Code
- there is laboratory capability to analyse tuna for levels of CO
- imported tuna can be inspected and analysed at the border to assess compliance with relevant requirements in the Code in relation to treatment with CO.

2.2 Survey method

The survey measured CO and histamine levels present in tuna flesh from 17 anonymously purchased samples from seafood markets and seafood retailers in Melbourne and Sydney where suspected CO treated tuna was being sold between May to July 2017. The intention was to sample packaged imported product that was both CO treated and not CO treated. No information was available at the place of purchase on whether the samples had been treated with CO or imported. Due to these limitations, two control samples were obtained to use as a baseline for the results, one sample that was known to have been treated with filtered smoke and one that was known not to have been treated.

Sample testing for CO and histamine levels was undertaken by the National Measurement Institute (NMI) using the methods outlined in Table 1.

Table 1. Description of methods of analysis and minimum limits of reporting

Analyte	Method description	Minimum limit of reporting
Carbon monoxide	Determination of hydrocarbons and permanent gases by gas chromatography connected to a thermal conductivity detector (GC-TCD)	100 µg/kg
Histamine	Method of test for the determination of histamine levels in fish and fish products/seafoods by fluorometric method (AS 4884 – 2008)	10 mg/kg

3 Results

3.1 Levels of carbon monoxide

Results for the 17 samples of tuna tested are provided in Table 2 and Figure 21. The results ranged from 150 to 2 300 µg/kg (Table 1). Fourteen of the seventeen samples exceeded the 200 µg/kg regulatory action level set by the EU and Japan (Feldhusen, Rehbein & Kruse 2004). Figure 2 is a picture of one of the samples where the CO level was well above 200 µg/kg.

3.2 Levels of histamine

Results for the 17 samples of tuna tested are provided in table 1. All samples had histamine levels <10 mg/kg, which is below the maximum level of histamine in fish and fish products of 200 mg/kg, as specified in Schedule 19 of the Code.

Table 2. Levels of CO and histamine in tuna fillets sampled at retail

Sample reference	CO detected (µg/kg)	Histamine (mg/kg)
Control (non-CO treated)	<100	<10
Control (CO treated)	1 500	<10
CERC00185	380	<10
CERC00186	150	<10
CERC00199	1 700	<10
CERC00200	150	<10
CERC00300	380	<10
CERC00301	570	<10
CERC00302	1 400	<10
CERC00303	<200	<10
CERC00304	480	<10
CERC00319	800	<10
CERC00320	320	<10
CERC00321	630	<10
CERC00322	1 100	<10
CERC00324	2 300	<10
CERC00325	460	<10
CERC00326	230	<10
CERC00327	370	<10

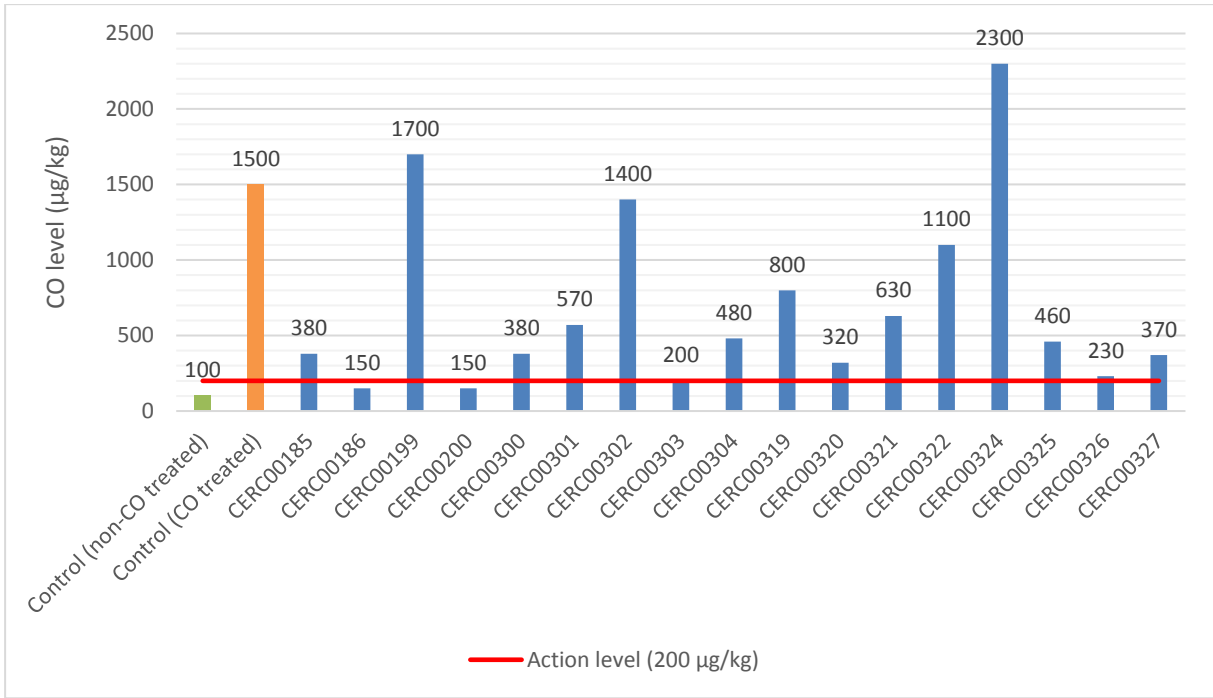


Figure 1. CO levels in samples with comparison to the EU/Japan action level



Figure 2. Sample CERC00199 (1 700 µg/kg of CO) with a ‘fresh’ pink appearance

4 Discussion

The CO level detected in the non-CO treated control sample (<100 µg/kg) is consistent with reported levels formed naturally in tuna flesh (20 to 50 µg/kg) (Feldhusen, Rehbein & Kruse 2004), noting the minimum detection level for CO undertaken by the NMI was 100 µg/kg. The CO level detected in the CO treated control sample (1 500 µg/kg) was also consistent with expectations, well above those expected to have formed naturally.

All samples of tuna recorded a CO level higher than expected for non-CO treated fish, and fourteen of the seventeen samples recorded a CO level higher than the 200 µg/kg regulatory action level set by the EU and Japan (Feldhusen, Rehbein & Kruse 2004). These results suggest that a high proportion of fish tested in this survey may have been gas flushed with CO or filtered smoke, and hence would not meet the requirements in Standard 1.3.3 and Standard 1.2.2 of the Code. It is unclear whether the fish sampled may have been treated pre-border or post-border.

Histamine levels were tested to assess the risk of histamine fish poisoning in non-CO treated and CO treated fish. Food treated with CO can mask the decomposition of fish, thus increasing the risk of histamine fish poisoning occurring (FSANZ 2013).

Schedule 19 of the Code sets a maximum level of histamine allowed in fish and fish products at 200 mg/kg. All samples recorded an acceptable level of histamine with no detectable levels present (<10 mg/kg). As the age of the samples taken is unknown, no definitive conclusion can be made from these results regarding risks to the safety of fish that have been gas flushed with CO or filtered smoke.

5 Conclusions/recommendations

The results of the pilot survey provided evidence that tuna sold at retailers in Australia may be treated with CO, either gas flushed with CO or filtered smoke. However, the survey did not provide evidence that tuna treated with CO is likely to have high levels of histamine present, as all samples tested were well within the legal limits.

This study also confirmed that laboratory capability exists in Australia to reliably test for CO and histamine levels in fish. However, at this time the capability does not exist to determine what method has been used to treat fish with CO.

As there are restrictions in the Code on the use of CO as a processing aid, it is recommended that imported tuna referred for inspection and analysis under the IFIS be inspected and analysed to assess compliance as follows:

- tuna fillets, where there is no documentation or labelling indicating the product has been treated directly or indirectly with CO, are tested for levels of CO and failed if levels exceed 200 µg/kg
- tuna fillets, labelled as having being treated with a filtered, odourless or tasteless smoke in the ingredient list, be failed unless the product is clearly identified as having being 'smoked'
- tuna fillet, labelling as having being treated with CO, be failed.

It is also recommended that the department continues to engage in discussions with relevant stakeholders in relation to filtered smoked fish to ensure at-border management remains consistent with the domestic approach.

Acronyms, abbreviations and commonly used terms

CO	Carbon monoxide
the Code	Australia New Zealand Food Standards Code
the Department	Department of Agriculture and Water Resources
the EU	European Union
FSANZ	Food Standards Australia New Zealand
ISFR	Implementation Subcommittee for Food Regulation
NATA	National Association of Testing Authorities, Australia
NMI	National Measurement Institute

References

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