MONITORING PROGRAMME FOR VETERINARY CONTROL ON SEAFOOD PRODUCTS IMPORTED TO NORWAY FROM THIRD COUNTRIES – RESULTS FROM 2019

In accordance with Commission Regulation (EC) No 136/2004, Annex II, Part 1

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This report summarises results from the ongoing monitoring programme for veterinary border control on seafood products imported to Norway from countries outside the EU and the European Economic Area from 2019. The Institute of Marine Research (IMR) carried out the analytical work on behalf of the Norwegian Food Safety Authority (NFSA), in cooperation with the personnel at the Norwegian Border Inspection Posts (BIP). We want to thank NFSA for very good cooperation during the conduct of this monitoring programme. An up to date risk assessment for different groups of imported products, made the basis for the sampling plans and the selection of analytical activities. The current trend of hazards, as reported in The Rapid Alert System for Food and Feed (RASFF) notification system, the compositional nature of the products and the annual import quantity of relevant products, was evaluated in this risk assessment. A total of 129 samples from the NFSA, collected at the BIPs, were examined by a selection of analytical methods and assays for microorganisms and undesirable chemical substances. The analytical data are listed in Annex 1 and are summarised below.

Microbiological analyses were performed on 94 samples. The microbiological quality parameters and indicator organisms for faecal contamination generally showed low numbers. However, higher counts were found in one sample of Malabar blood snapper (*Lutjanus malabaricus*) imported from Sri Lanka, and in one sample of swim bladder, one sample sweet chili marinated prawns and one sample of purpleback squid, all imported from Vietnam. Further, *Listeria monocytogenes* was detected in low quantity in one sample of tilapia from China. No samples had pathogens in the genera *Salmonella* or *Vibrio*, whereas Enterobacteriaceae was detected in one sample of fish cakes imported from China. Ten samples were examined for the presence of mould and yeast. Their presence was detected in one sample of swim bladder from Vietnam, and one sample of Atlantic cod from China. Two samples were analysed and showed no presence of antibiotic resistant Enterobacteriaceae. One sample of Pacific oysters was examined for the presence of *Escherichia coli* and norovirus and was found to be negative for both. Eight seafood samples originating from aquaculture were analysed for residues of prohibited veterinary medicines, unauthorised dyes and antibacterial agents. None of these were detected. Two samples were analysed for carbon monoxide and no indication for a treatment with CO was found. The chemical spoilage indicator histamine was examined in twenty-six samples and all results were compliant with the maximum levels.

Undesirable trace elements were measured in 116 samples and only one sample exceeded the maximum level. This was a sample of Obtuse barracuda (*Sphyraena obtusata*) from Sri Lanka with a mercury concentration of 0.78 mg/kg ww.

Thirty-one samples were analysed for the persistent organic pollutants dioxins/ furans and PCBs (DLPCBs and NDLPCBs), the PBDE class of compounds and all sample were compliant. The levels of PBDEs in thirty-one samples, were within a range commonly observed in seafood. For the PAH class of compounds, one sample was analysed, and found compliant with its maximum levels.

Innhold

1 - Introduction

As a member of the European Economic Area (EEA), Norway is obliged to monitor the conformity of products imported to the EEA area. As part of this activity, analytical examinations of seafood with respect to microorganisms, parasites and the presence of undesirable substances are conducted. The Norwegian Food Safety Authority (NFSA) is the competent authority regarding veterinary border control in Norway. On behalf of NFSA, IMR have carried out the analytical examination of the seafood samples in this monitoring programme and elaborated this report.

According to Commission Regulation (EC) No 136/2004 (EU 2004, FOR-2015-11-30-1347) the monitoring plans must be based upon the nature of the products and the potential risks associated with the different product categories, concidering all relevant factors such as frequency and number of incoming consignments and results from previous monitoring. The selection of parameters included in the current analytical activity was based on previous findings in this program, as well as information available in the RASFF, “Rapid Alert System for Food and Feed” system of the European commission.

The spectrum of products examined by NFSA at veterinary border inspection points is large, as it reflects the annual flux and variation in the import activity. Thus, the methods used to examine the products are also diverse.

Microbiological parameters are used to evaluate the safety and quality of seafood products and if proper hygienic measures were applied during production. To evaluate possible fecal contamination, analysis for common indicator organisms were conducted, including assays for coliforms, bacteria in the Enterobacteriaceae family and enterococci. Furthermore, samples were analyzed for specific pathogens relevant for food safety, including bacteria in the geni *Salmonella* , *Listeria* and *Vibrio* . EU microbiological criteria, which Norway has implemented through the EEA agreement, have been established for *Salmonella* and *Listeria monocytogenes* (Commission Regulation 2073/2005).

Antimicrobial resistance is a prevalent challenge to global public health. Extended-spectrum β-lactamase (ESBL)-producing Enterobacteriaceae are priority pathogens for which research and urgent development of new antibiotics is needed (WHO 2017) . Carbapenem resistant Enterobacteriaceae have been detected in sea food imported from South East Asia (Janecko, Martz et al. 2016) . Although this is true, there are currently no regulations on screening of these antibiotic resistant pathogens in imported seafood.

According to current EU legislation (Directive 96/23), some drugs are illegal to use in animals intended for food production. Thus, samples from aquaculture were analyzed for such agents. Chloramphenicol is an antibiotic agent with activity against a broad spectrum of microorganisms. Due to a rare but serious dose-independent adverse effect (aplastic anaemia), this agent is not authorized in the treatment of food-producing animals, including fish. Nitrofuranes were previously widely used in veterinary medicine as an antimicrobial agent. They were banned from use in the European Union (EU) in 1995 due to concerns about the carcinogenicity of their residues in edible tissue. Relevant farmaceuticals were analysed in farmed seafood products.

The survey included the chemical spoilage indicator histamine.

Carbon monoxide (CO) is used to treat fresh fish and especially tuna to retain a fresh, red appearance for a longer period. It reacts with the oxy-myoglobin to form a rather stable cherry red carboxy-myoglobin complex. No direct health implications from eating CO-treated fish is known, however, the practice is problematic, because it may mask spoilage, as the CO-complex can be stable beyond the microbiological shelf life of the meat. As no official maximum level is set, samples were judged as CO treated when their levels were higher than 200 ng/g according to Marrone et al. (2015) .

Undesirable trace elements relevant for seafood safety occur naturally in the environment with large geographical variations, due to their geological presence. Furthermore, they are released from anthropogenic sources. These compounds may to some extent accumulate in food chains and thus find their way into wild caught seafood. Cultured seafood can be affected via contaminated feed. As implemented in in EC 1881/2006, the elements cadmium (Cd), mercury (Hg), and lead (Pb), were measured and the compliance of the values with the maximum levels was evaluated. Arsenic (As), although exhibiting a low level of toxicity in seafood, was also included. There is no maximum level for As in seafood, in contrast to the legislation concerning terrestrial foods.

Persistent organic pollutants form a heterogeneous group of lipophilic substances that exhibit a range of chemical and toxicological characteristics. They are persistent in the environment and accumulate in food chains. Some classes of POPs are considered a dietary hazard to human health. The compliance of selected samples with the established maximum levels for food stuffs (EC 1881/2006) was evaluated for the contaminats: dioxins, furans, and dioxin-like PCBs, the EU selected “non-dioxin like-PCBs”, and for the polyaromatic hydrocarbons (PAH). Flame-retardant compounds in the polybrominated diphenyl ethers family (PBDEs) were also measured. P BDEs are found in plastics, textiles, electronic castings and circuitry. As these products age and eventually are discarded, the PBDEs finds their way into the environment and from there, into biota and into food and feed. The EU recommends a monitoring of the BDE compound class in food (EU 2014) . However, n o maximum limits have been established in food. EFSA performed a risk assessment of BDEs in food in 2011 (EFSA CONTAM Panel 2011) . They concluded that the current dietary exposures of BDE-47, -153 and -209 did not raise health concerns. However, the current dietary exposure of BDE-99 was labelled a potential health concern .

2 - Materials and methods

Sampling was carried out by NFSA at the Norwegian Border Inspection Posts (BIPs) while analytical examinations and the writing of this report was conducted by IMR. The sampling targeted hazards associated with each kind of imported products, and took into account import volumes, compositional nature of the products, results from previous monitoring, geographical origin of samples, and information available in the Rapid Alert System for Food and Feed (RASFF). This report concerns samples imported to Norway in 2019.

Fresh sample were directly shipped to IMR and frozen samples were stored frozen in the BIPs until shipment in the frozen state to IMR for analysis. Upon arrival, samples were registered at the IMR sample reception unit, each sample photographed, and relevant information registered in a Laboratory Information Management System (LIMS). The microbiological assay was carried out prior to all other sample handling. The sample was then further prepared for analyses and split in sub-samples (aliquots) for the different assays and analytical methods.

In general, the edible part of the samples for human consumption was selected for analyses, according to a manual with specific instructions for each kind of sample. For undesirable species where a legal maximum level was defined, the tissue specified in the regulation was selected. The analytical methods and procedures used were accredited according to the ISO 17025 standard, unless otherwise specified. A summary of the chemical analytical methods, accreditation status and their performance data are listed in Annex 2.

The evaluations of the analytical data in the report is based primarily on the EU maximum levels (Commission Regulation (EU) No. 2006/1881, of which a summary is presented in Annex 3 of this report; Commission Regulation (EU) No. 2073/2005, 37/2010 and 1019/2013) and EU recommendations. The maximum levels provide a legal framework for trade. For undesirables with no maximum level in place, the reference basis selected for the discussion/ interpretation were published opinions or food safety evaluations from scientific expert committees (when available), or the analytical range commonly observed for this undesirable in seafood from pristine or semi-pristine waters.

3 - Results and discussion

A total of 129 samples from the NFSA at Norwegian BIPs, were examined by a selection of methods for microorganisms and undesirable chemical species as shown in the table below. Data tables are presented in Annex 1. Method performance data are listed in Annex 2. A summary of EU maximum levels for certain contaminants in foodstuffs are listed in Annex 3.

Samples and assays included in the Norwegian veterinary border control of seafood 2019								
	Fish	Crustaceans	Cephalopods	Bivalves	Feed/ flour	Marine Oils	Other	Total number
Microbiology	53	14	3	1	2	10	11	94
Antibiotic resistance	0	2	0	0	0	0	0	2
Drug residues and dyes	6	2	0	0	0	0	0	8
Chemical spoilage indicators	12	0	0	0	0	0	14	26
Carbon monoxide	2	0	0	0	0	0	0	2
Undesirable trace elements	52	13	2	1	2	10	36	116
POPs (PCDD/F, PCB, PBDE)	12	0	1	0	0	3	15	31
PAH	0	0	0	0	0	0	1	1

3.1 - Microbiology

The detailed results from the microbiological examinations are listed in Annex 1 (Table 1). A total of 94 samples were examined for microorganisms by a range of assays.

One sample of Pacific oysters was examined for *E. coli* by the Donovan method as specified by EU, and < 18 bacteria/100 gram sample material was found (result not shown in table). The same sample was examined for the presence of Norovirus by RT-PCR in accordance with ISO15216-1 (Horizontal method for determination of hepatitis A virus and norovirus in food using real-time RT-PCR -Part 1: Method for quantification), and this was also negative.

Sixty-nine samples were analysed for coliforms by the 3M TM Petrifilm method, and numbers above the detection level of 10 colony forming units (cfu)/g were found in four samples. One sample of Malabar blood snapper from Sri Lanka had 50 coliforms/g, and three samples from Vietnam where the products were swim bladder (species unknown), Sweet chili marinated prawns and Purpleback squid had 370, 30 and 200 coliforms/g respectively. Determination of thermotolerant coliforms by 3M TM Petrifilm found that one sample of shrimp flour from Thailand had 10 cfu/g, and one sample of swim bladder from Vietnam had 330 cfu/g. All other results for the determination of thermotolerant coliforms were below the detection limit of 10 cfu/g.

Twenty samples were analysed for the presence of coagulase positive *Staphylococcus* , and all were under the levels of detection (100 cfu/g). Twenty-six samples analysed for the presence of anaerobic sulphite-reducing bacteria were all under the detection limit of 100 cfu/g. Six samples were anlysed for Enterobacteriaceae, and one sample of fish cakes from China was over the detection limit (10 cfu/g) with 40 cfu/g. Seventy-one samples were analysed for the presence of enterococci, and all were below the detection limit of 100 cfu/g.

Sixty-four samples were were analysed for *L. monocytogenes* and the bacterium was detected qualitatively in one sample of tilapia from China. The sample was further examined quantitatively, and the number of *L. monocytogenes* was found to be below the detection limit of 10 cfu/g.

No pathogens in the genus *Salmonella* (n=94 samples) were detected, and neither was *Vibrio* sp. (n=17).

Ten samples were examined for the presence of mould and yeast. The same sample of swim bladder from Vietnam that showed detection levels of coliforms and thermotolerant coliforms also had elevated levels of mould and yeast, with 2200 and 200 cfu/g respectively. One additional sample of Atlantic cod had 100 and 200 cfu/g of yeast and mould respectively. The other samples were all below detection limit of 100 cfu/g.

3.2 - Antibiotic resistance

Two samples of shrimps imported from Vietnam were checked for the presence of ESBL/Carbapenemase producing Enterobactereciae. None of the samples showed presence of these resistant pathogens (Annex 1, Table 2). This is in accordance with the results from detection of coliforms in these samples.

3.3 - Drug residues and dyes

Eigth samples originating from aquaculture were analysed for residues of prohibited veterinary medicines (unauthorised dyes and antibacterial agents). The analysis included the dye compounds crystal violet (CV), leuco crystal violet (LCV), malachite green (MG), leuco malachite green (LMG), brilliant green (BG), and the antibacterial agents chloramphenicol and nitrofuran metabolites. None unauthorised dyes were detected in any of the analysed samples, nor were any traces of chloramphenicol or nitrofuranes found. Details of analysed samples are given in Annex 1, Table 3 (unauthorised dyes) and Table 4 (antibacterial agents).

3.4 - Chemical spoilage indicators

The chemical spoilage indicator histamine was examined in a total of twenty-six samples (Annex 1, Table 5). All results were compliant. The highest histamine value of 44 mg/kg ww was found in samples of Indian mackerel (*Clarias* sp.).

3.5 - Carbon monoxide

Two samples were analysed for carbon monoxide and no indication for a treatment with CO was found (Annex 1, Table 6).

3.6 - Undesirable trace elements

The concentrations of the elements arsenic (As), cadmium (Cd), lead (Pb) and mercury (Hg) were examined in 116 samples, selected by criteria intended to maximize the probability of finding non-compliant concentrations. The analytical data are listed in Annex 1, Table 7.

In most seafood, arsenic is mainly present as organo-metal chemical species of low toxicity, such as arsenobetaine and arsenolipids. This characteristic of marine foods set them apart from foods of terrestrial origin, in which toxic inorganic arsenic species give a significant contribution to the elemental arsenic concentration. Thus, in 2019 no relevant maximum level on elemental As was in place for the samples analysed. The observed values for elemental As were mostly within the range occasionally observed in seafood from pristine waters. However, two samples of Pandalus shrimp from the Russian Federation, were measured with relatively high concentrations of 800 and 700 mg/kg ww respectively. These high values are consistent with 2018 results, where two samples of Pandalus shrimp from the Russian Federation were measured with high values.

A sample of dry prawn powder made of *Pandalus borealis* , imported from Albania, exhibited a high Cd value of 5.5 mg/kg dw. However, on request, the producer reported a processing factor of 10% from fresh shrimps to the ready dried product analysed here. If the processing factor and the measurement uncertainty of the method would be taken into account, the maximum level of 0.5 mg/kg ww would not be exceeded .

The second highest value of 0.53 mg Cd/kg dw was found in dried cuttlefish *Sepiella japonica* , declared as not intended for human consumption. Thus, it was compliant in respect to the maximum limit. The average Cd concentration in a sample of dried and frozen anchovy, *Stolephorus* spp. was measured to be 0.24 mg/kg dw. Assuming the consumption of whole fish, the maximum limit of 0.05 mg/kg ww would be exceeded without considering a processing factor. However, if considering a dry matter content of 25%, as often found in other anchoyy species like *Engraulis* spp., and the uncertainty of the measurement, the maximum level would not be exceeded. All other values were below their respective maximum levels.

A significant part of the elemental mercury (Hg) in seafood is present as methylmercury, a compound with a documented toxic character. Thus, there are maximum levels in place for Hg in seafood. However,they are provided in terms of the total elemental concentration (EU 2006) (Annex 3). The highest concentration of Hg was found in a fillet from Obtuse barracuda (*Sphyraena obtusata*) from Sri Lanka with 0.78 mg/kg ww and was above the maximum level.

For elemental lead (Pb), all measured values were below their respective maximum levels.

3.7 - Persistent organic pollutants (POPs)

A selection of thirty-one of the most relevant samples were analysed for dioxins (PCDDs), furans (PCDFs) dioxin-like PCBs (DL-PCBs), non-dioxin-like PCBs (NDLPCBs), also referred to as: EU-PCB $_6$ or “indicator” PCBs and polybrominated flame-retardants (PBDEs). PAHs were analysed in one sample, for which a maximum level was provided. Annex 3 provides a summary of the most relevant maximum levels.

3.7.1 - Dioxins (PCDDs), furans (PCDFs) and Polychlorinated Bifenyls (PCBs)

Table 8 lists the sum values of PCB, dioxins and furans, in terms of the summed dioxin like PCBs (DL-PCBs), the summed non-dioxin like PCBs (NDL-PCBs), and the summed PCDDs and PCDFs, each sum calculated for each of the analysed samples. The maximum levels are defined in terms of upper bound (EU 2006, EU 2011) sum-parameters except for the sum-parameter NDL-PCBs which is the summed analytical concentration, based on the ng/g w.w. scale. The other sum-parameters are measured in the TEQ pg/g w.w. scale (toxic equivalents): in effect summing toxicities rather than their analytical concentrations (EU 2006) . The choice of scale is in line with the scales used for the EU maximum levels.

All measured values of 2019 were below their respective maximum limits.

3.7.2 - Polybrominated diphenyl ethers (PBDEs or BDEs)

The data for seven individual BDE congeners (BDE-28, 47, 99, 100, 153, 154 and 183) and their upper bound sum (BDE7) for the thirty one samples are listed in Annex 1, Table 9. All the measured values were within a range occasionally observed in seafood from pristine waters.

3.7.3 - Polyaromatic hydrocarbons (PAH)

PAH-compounds are generated from incomplete combustion of organic matter. In food processing PAHs may be formed from over-heating, and they find their way into smoked products from the smoking process. Bivalves can be contaminated from environmental PAH pollution adsorbed to water-suspended particles when these are ingested by the bivalve. There is a high number of compounds in this class. A few of them exhibit food safety issues: Maximum levels are in place for bivalves and smoked products (Annex 3); for Benzo(a)pyrene (BaP) alone, as well as for the lower bound sum (EU 2006) (LB-sum) of four selected PAH compounds; BaP, Benzo(a) anthracene, Benzo(b)fluoranthene and chrysene (LB-sum PAH_4).

Only one sample was selected for PAH analysis, a smoked cod sample. Twenty individual PAH compounds were measured. Only the PAH data associated with a maximum level are listed. In this sample the measured values were below the maximum levels (Annex 1, Table 10).

4 - Conclusion

In total 129 samples, collected by the official staff at the Norwegian Border Inspection Posts of the Norwegian Food Safety Authority, were examined for selected chemical and microbiological undesirables in 2019

The results for microbiological quality parameters and indicator organisms for faecal contamination generally showed low numbers in the 94 examined samples. However, higher counts were found in some samples. One sample of swim bladder imported from Vietnam had 370 coliforms/g and 330 thermotolerant coliform/g. In addition, one sample of Malabar blood snapper from Sri Lanka had 50 coliforms/g , and two samples of sweet chili marinated prawns and purpleback squid, both from Vietnam, had 30 and 200 coliforms/g respectively. Further, *L. monocytogenes* was detected qualitatively in one sample of tilapia from China. The sample was further examined quantitatively, and the number of *L. monocytogenes* was found to be below the detection limit of 10 cfu/g. N o samples had pathogens in the genera *Salmonella* or *Vibrio* , whereas Enterobacteriaceae was detected in one sample of fish cakes imported from China. Ten samples were examined for the presence of mould and yeast. Their presence was detected in one sample of swim bladder from Vietnam, and one sample of Atlantic cod from China. One sample of Pacific oysters was examined for the presence of *E. coli* and Norovirus, and it was found to be negative for both.

Antibiotic resistant Enterobacteriaceae were not detected in two samples of shrimps imported from Vietnam.

Eight samples, originating from global aquaculture were examined for residues of selected prohibited pharmaceuticals. The examination included the dye compounds crystal violet, leuco crystal violet, malachite green, leuco malachite green and brilliant green and also chloramphenicol and nitrofuran metabolites. No unauthorised dyes, nor residues of prohibited antibacterial agents were detected .

The chemical spoilage indicator histamin was examined in 26 samples. All results were compliant with their maximum levels.

Carbon monoxide was measured in two tuna samples and no indication of usage was found

The undesirable trace elements arsenic, cadmium, mercury and lead, were measured in 116 samples. Regarding cadmium, two samples for human consumption showed elevated values. A sample of dry prawn powder, made of *Pandalus borealis* , imported from Albania, exhibited a concentration of 5.5 mg/kg dw and a sample of dried and frozen anchovy, *Stolephorus* spp., was measured to contain 0.26 mg Cd/kg dw. However, if considering processing factors and uncertainty of the method, the sample would be compliant.

One fillet sample of Obtuse barracuda (*Sphyraena obtusata*) from Sri Lanka exceeded the maximum level for mercury with a concentration of 0.78 mg/kg ww.

For lead, all measured values were compliant with their maximum limits. For arsenic there is currently no maximum limit in force for seafood, due to the low human toxicity of the marine molecular spesies of this element.

Concerning the POP compounds, 31 samples were analysed: For dioxins and furans, for PCBs, including the twelve dioxin like PCBs, and for the six EU selected non-dioxin like PCBs, and for seven polybrominated diphenyl ethers. All measured values were below the legal limits where limits were provided. Regarding PAHs, one sample was analysed in 2019. It was compliant with its maximum limits .

5 - References

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6 - ANNEX 1: Data tables

Table 1. Microbiological examination (n=94) Abbreviations: n.d.: not detected; D: detected; n.a.: not available;); CFU: Colony forming units.

						Indicator organisms (cfu/g) by agar method			Faecal indicator (by agar
						Enterococcus	*Coag. pos. Staphylo coccus*	Sulph.-red. bact.	Entero-bacteriaceae
Journal No.	Origin	Category	Species	Scientific name	Tissue/ sample type	/g	/g	/g	/g
2019-9/1	AUSTRALIA (AUS)	Fish	Yellowtail	*Seriola lalandi*	Muscle	< 100			
2019-10/1	AUSTRALIA (AUS)	Fish	Yellowtail	*Seriola lalandi*	Muscle with skin	< 100			
2019-14/1	ALBANIA (ALB)	Flour	Unknown	Unknown	Shrimpflour				< 10
2019-16/1	THAILAND (THA)	Other	Unknown	Unknown	Crabsticks		< 100		< 10
2019-17/1	CHINA (CHN)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-18/1	CHINA (CHN)	Fish	Blue grenadier	*Macruronus novaezelandiae*	Fillet	< 100			
2019-19/1	CHINA (CHN)	Fish	Pacific halibut	*Hippoglossus stenolepis*	Muscle	< 100			
2019-20/1	CANADA (CAN)	Crustaceans	Shrimp	*Pandalus borealis*	Whole	< 100			
2019-21/1	MYANMAR (MMR)	Other	Blue grenadier	*Macruronus novaezelandiae*	Battered	< 100			
2019-22/1	CHINA (CHN)	Fish	Alaska pollock	*Theragra chalcogramma*	Fillet	< 100			
2019-23/1	VIET NAM (VNM)	Other	Atlantic cod	*Gadus morhua*	Swim bladder	< 100	< 100	< 100	
2019-52/1	SRI LANKA (LKA)	Fish	Yellowfin tuna	*Thunnus albacares*	Muscle	< 100			
2019-53/1	SRI LANKA (LKA)	Fish	Obtuse barracuda	*Sphyraena obtusata*	Fillet	< 100			
2019-63/1	MALDIVES (MDV)	Fish	Yellowfin tuna	*Thunnus albacares*	Muscle	< 100			
2019-83/1	CHINA (CHN)	Oil	Unknown	Unknown	Oil			< 100	
2019-156/1	SRI LANKA (LKA)	Fish	Malabar blood snapper	*Lutjanus malabaricus*	Muscle	< 100			
2019-157/1	SRI LANKA (LKA)	Fish	Narrow-barred Spanish mackerel	*Scomberomorus commerson*	Fillet	< 100			

						Indicator organisms (cfu/g) by agar method			Faecal indicator by agar
						Enterococcus	***Coag. pos. Staphylococcus***	**Sulph.-red. bact.**	**Entero-bacteriaceae**
Journal No.	**Origin**	**Category**	**Species**	**Scientific name**	**Tissue/ sample type**	**/g**	**/g**	**/g**	**/g**
2019-177/1	VIET NAM (VNM)	Other	Unknown	Unknown	Swim bladder	< 100	< 100	< 100	
2019-252/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-253/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-254/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-275/1	THAILAND (THA)	Fish	Anchovy	*Stolephorus spp.*	Whole	< 100	< 100	< 100	
2019-334/1	SRI LANKA (LKA)	Fish	Giant trevally	*Caranx ignobilis*	Muscle	< 100			
2019-336/1	CHINA (CHN)	Other	Unknown	Unknown	Fish cakes		< 100		40
2019-337/1	MALAYSIA (MYS)	Other	Argentine red shrimp	*Pleoticus muelleri*	Battered	< 100			
2019-413/1	SRI LANKA (LKA)	Fish	Yellowfin tuna	*Thunnus albacares*	Muscle	< 100			
2019-438/1	RUSSIAN FEDERATION (RUS)	Fish	Haddock	*Melanogrammus aeglefinus*	Muscle	< 100			
2019-439/1	RUSSIAN FEDERATION (RUS)	Fish	Rose fish	*Sebastes norvegicus*	Whole, gutted, headless	< 100			
2019-506/1	VIET NAM (VNM)	Fish	Yellowfin tuna	*Thunnus albacares*	Muscle	< 100			
2019-507/1	CHINA (CHN)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-508/1	CHINA (CHN)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-509/1	VIET NAM (VNM)	Crustacean	Brown crab	*Cancer pagurus*	White meat		< 100	< 100	
2019-510/1	THAILAND (THA)	Other	Indian mackerel	*Rastrelliger kanagurta*	Steamed, frozen	< 100	< 100	< 100	
2019-529/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-605/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Fillet	< 100			

						Indicator organisms (cfu/g) by agar method			Faecal indicator by agar
						Enterococcus	***Coag. pos. Staphylo coccus***	**Sulph.-red. bact.**	**Entero-bacteriaceae**
Journal No.	**Origin**	**Category**	**Species**	**Scientific name**	**Tissue/ sample type**	**/g**	**/g**	**/g**	**/g**
2019-638/1	VIET NAM (VNM)	Crustacean	Whiteleg shrimp	*Penaeus vannamei Boone*	Peeled	< 100			
2019-639/1	CANADA (CAN)	Crustacean	Northern shrimp	*Pandalus borealis*	Whole		< 100	< 100	
2019-662/1	PERU (PER)	Oil	Anchovy	*Engraulis sp.*	Oil			< 100	
2019-715/1	RUSSIAN FEDERATION (RUS)	Crustacean	Shrimp	*Pandalus borealis*	Whole	< 100			
2019-974/1	VIET NAM (VNM)	Crustacean	Whiteleg shrimp	*Penaeus vannamei Boone*	Peeled		< 100	< 100	
2019-975/1	VIET NAM (VNM)	Fish	Indian Mackerel	*Rastrelliger Kanagurta*	Whole	< 100			
2019-976/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Fillet	< 100			
2019-977/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Fillet	< 100			
2019-978/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Fillet	< 100			
2019-978/2	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Whole, gutted, headless	< 100			
2019-979/1	RUSSIAN FEDERATION (RUS)	Fish	Saithe	*Pollachius virens*	Fillet	< 100			
2019-979/2	RUSSIAN FEDERATION (RUS)	Fish	Saithe	*Pollachius virens*	Whole, gutted, headless	< 100			
2019-980/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Fillet	< 100			
2019-988/1	CANADA (CAN)	Crustacean	American lobster	*Homarus americanus*	Whole	< 100			
2019-1012/1	VIET NAM (VNM)	Cephalopod	Baby Cuttlefish	*Sepiella japonica*	Whole	< 100			
2019-1013/1	VIET NAM (VNM)	Fish	Catfish	*Clarias sp.*	Whole	< 100			
2019-1050/1	MOROCCO (MAR)	Oil	Anchovy	*Engraulis sp.*	Oil			< 100	
2019-1051/1	MOROCCO (MAR)	Oil	Anchovy	*Engraulis sp.*	Oil			< 100	

						Indicator organisms (cfu/g) by agar method			Faecal indicator by agar
						Enterococcus	***Coag. pos. Staphylo coccus***	**Sulph.-red. bact.**	**Entero-bacteriaceae**
Journal No.	**Origin**	**Category**	**Species**	**Scientific name**	**Tissue/ sample type**	**/g**	**/g**	**/g**	**/g**
2019-1099/1	ARGENTINA (ARG)	Cephalopod	Argentine shortfin squid	*Illex argentinus*	Whole	< 100			
2019-1127/1	RUSSIAN FEDERATION (RUS)	Crustacean	Shrimp	*Pandalus borealis*	Whole	< 100			
2019-1128/1	RUSSIAN FEDERATION (RUS)	Crustacean	Shrimp	*Pandalus borealis*	Whole	< 100			
2019-1336/1	TAIWAN, PROVINCE OF CHINA (TWN)	Fish	Pacific saury	*Cololabis Saira*	Whole	< 100			
2019-1370/1	THAILAND (THA)	Flour	Shrimp	Unknown	Flour				< 10
2019-1374/1	CHINA (CHN)	Fish	Saithe	*Pollachius virens*	Muscle	< 100			
2019-1522/1	RUSSIAN FEDERATION (RUS)	Crustacean	Shrimp	*Pandalus borealis*	Whole		< 100	< 100	
2019-1523/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic mackerel	*Scomber scombrus*	Whole	< 100			
2019-1524/1	CHINA (CHN)	Fish	Alaska pollock	*Theragra chalcogramma*	Muscle	< 100	< 100	< 100	
2019-1525/1	CHINA (CHN)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-1526/1	CHINA (CHN)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-1527/1	CANADA (CAN)	Crustacean	Shrimp	*Pandalus borealis*	Peeled		< 100	< 100	
2019-1528/1	UNKNOWN	Bivalve	Pacific oyster	*Crassostrea gigas*	Muscle	< 100			
2019-1529/1	CHINA (CHN)	Fish	Alaska pollock	*Theragra chalcogramma*	Fillet	< 100			
2019-1530/1	MALAYSIA (MYS)	Other	Hoki	*Macruronus sp.*	Battered	< 100			
2019-1531/1	CHINA (CHN)	Oil	Squid	Unknown	Oil			< 100	
2019-1532/1	MOROCCO (MAR)	Oil	Fish	Unknown	Oil			< 100	
2019-1533/1	THAILAND (THA)	Other	Unknown	Unknown	Crabsticks		< 100		< 10
2019-1614/1	PERU (PER)	Oil	Anchovy	*Engraulus ringens*	Oil			< 100	

						Indicator organisms (cfu/g) by agar method			Faecal indicator (by agar
						Enterococcus	***Coag. pos. Staphylo coccus***	**Sulph.-red. bact.**	**Entero-bacteriaceae**
Journal No.	**Origin**	**Category**	**Species**	**Scientific name**	**Tissue/ sample type**	**/g**	**/g**	**/g**	**/g**
2019-1616/1	VIET NAM (VNM)	Fish	Tuna	*Scombridae sp.*	Muscle	< 100			
2019-1622/1	VIET NAM (VNM)	Other	Whiteleg shrimp	*Penaeus Vannamei*	SweetChili Marinated	< 100			
2019-1630/1	MAURITUS (MUS)	Fish	Tuna	*Scombridae sp.*	Muscle	< 100			
2019-1635/1	VIET NAM (VNM)	Crustacean	Whiteleg shrimp	*Penaeus vannamei Boone*	Peeled		< 100	< 100	
2019-1644/1	RUSSIAN FEDERATION (RUS)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-1831/1	TAIWAN, PROVINCE OF CHINA (TWN)	Fish	Pacific saury	*Cololabis Saira*	Whole	< 100			
2019-2009/1	VIET NAM (VNM)	Cephalopod	Purpleback squid	*Sthenoteuthis oualaniensis*	Whole	< 100			
2019-2094/1	CHINA (CHN)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100	< 100	< 100	
2019-2095/1	CHINA (CHN)	Fish, smoked	Atlantic cod	*Gadus morhua*	Muscle	< 100	< 100	< 100	
2019-2096/1	CHINA (CHN)	Fish	Atlantic cod	*Gadus morhua*	Muscle	< 100			
2019-2097/1	CHINA (CHN)	Fish	Pacific Cod	*Gadus macrocephalus*	Muscle	< 100	< 100	< 100	
2019-2098/1	CHINA (CHN)	Fish	Saithe	*Pollachius virens*	Muscle	< 100	< 100	< 100	
2019-2116/1	SRI LANKA (LKA)	Fish	Yellowfin tuna	*Thunnus albacares*	Muscle	< 100			
2019-2119/1	AUSTRALIA (AUS)	Fish	Yellowtail	*Seriola lalandi*	Muscle	< 100			
2019-2129/1	VIET NAM (VNM)	Crustacean	Whiteleg shrimp	*Penaeus vannamei Boone*	Peeled		< 100	< 100	
2019-2130/1	THAILAND (THA)	Other	Unknown	Unknown	Crabsticks		< 100		< 10
2019-2131/1	CHINA (CHN)	Fish	Tilapia	*Sarotherodon galilaeus*	Fillet	< 100			
2019-2132/1	VIET NAM (VNM)	Fish	Striped catfish	*Pangasius hypophthalmus*	Muscle	< 100			
2019-2184/1	CANADA (CAN)	Crustacean	American lobster	*Homarus americanus*	White meat	< 100			

						Indicator organisms (cfu/g) by agar method			Faecal indicator (by agar	
						Enterococcus	*Coag. pos. Staphylo coccus*	Sulph.-red. bact.	Entero-bacteriaceae	
Journal No.	Origin	Category	Species	Scientific name	Tissue/ sample type	/g	/g	/g	/g	
2019-2312/1	MOROCCO (MAR)	Oil	Anchovy	*Engraulis ringens*	Oil			< 100		
2019-2313/1	MOROCCO (MAR)	Oil	Anchovy	*Engraulis ringens*	Oil			< 100		
2019-2314/1	MOROCCO (MAR)	Oil	Fish	Unknown	Oil			< 100		

Table 2. Antibiotic resistance (n=2)

Journal No.	Origin	Category	Species	Scientific name	ESBL- producing Enterobacteriaceae	Carbapenemase- producing Enterobacteriaceae
2019-638/1	VIETNAM (VNM)	Aquaculture	Whiteleg shrimp	*Penaeus vannamei* Boone	n.d.	n.d.
2019-974/1	VIETNAM (VNM)	Aquaculture	Whiteleg shrimp	Penaeus vannamei Boone	n.d.	n.d.

Journal No.	Origin	Group	Species	Scientific name	Tissue	CV LOD: 0.3 µg/kg	LCV LOD: 0.15µg/kg	MG LOD: 0.15µg/kg	LMG LOD: 0.15µg/kg	BG LOD: 0.15 µg/kg
2019-638/1	VNM	Crustacean	Whiteleg shrimp	*Penaeus vannamei* Boone	White meat	n.d.	n.d.	n.d.	n.d.	n.d.
2019-974/1	VNM	Crustacean	Whiteleg shrimp	*Penaeus vannamei* Boone	White meat	n.d.	n.d.	n.d.	n.d.	n.d.
2019-1013/2	VNM	Limnic Fish	*Clarias* sp.	*Clarias* sp.	Filet	n.d.	n.d.	n.d.	n.d.	n.d.
2019-2131/1	CHN	Limnic Fish	Tilapia	*Sarotherodon galilaeus*	Filet	n.d.	n.d.	n.d.	n.d.	n.d.
2019-2132/1	VNM	Marine Fish	Striped catfish	*Pangasius hypophthalmus*	Filet	n.d.	n.d.	n.d.	n.d.	n.d.
2019-9/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	n.d.	n.d.	n.d.	n.d.	n.d.
2019-10/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet/skin	n.d.	n.d.	n.d.	n.d.	n.d.
2019-2119/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	n.d.	n.d.	n.d.	n.d.	n.d.

Table 4. Residues of prohibited veterinary Antibacterial agents, Chloramphenicol and nitrofuran metabolites (n=8). Abbreviations: n.d.: not detected, CAM: chloramphenicol, AHD: 1-amino-hydantoin, AOZ: 3-amino-2-oxazolidinone, AMOZ: 3-amino-5-morpholinomethyl-2-oxazolidinone, SEM: semicarbazide

Journal No.	Origin	Group	Product	Scientific name	Tissue	CAM LOD: 0.25 µg/kg	AHD LOD: 0.6 µg/kg	AOZ LOD: 0.5 µg/kg	AMOZ LOD: 0.4 µg/kg	SEM LOD: 0.5 µg/kg
2019-638/1	VNM	Crustacean	Whiteleg shrimp	*Penaeus vannamei* Boone	White meat	n.d.	n.d.	n.d.	n.d.	n.d.
2019-974/1	VNM	Crustacean	Whiteleg shrimp	*Penaeus vannamei* Boone	White meat	n.d.	n.d.	n.d.	n.d.	n.d.
2019-1013/2	VNM	Limnic Fish	Clarias sp.	*Clarias* sp.	Filet	n.d.	n.d.	n.d.	n.d.	n.d.

Journal No.	Origin	Group	Product	Scientific name	Tissue	CAM LOD: 0.25 µg/kg	AHD LOD: 0.6 µg/kg	AOZ LOD: 0.5 µg/kg	AMOZ LOD: 0.4 µg/kg	SEM LOD: 0.5 µg/kg
2019-2131/1	CHN	Limnic Fish	Tilapia	*Sarotherodon galilaeus*	Filet	n.d.	n.d.	n.d.	n.d.	n.d.
2019-2132/1	VNM	Marine Fish	Striped catfish	*Pangasius hypophthalmus*	Filet	n.d.	n.d.	n.d.	n.d.	n.d.
2019-9/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	n.d.	n.d.	n.d.	n.d.	n.d.
2019-10/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet/skin	n.d.	n.d.	n.d.	n.d.	n.d.
2019-2119/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	n.d.	n.d.	n.d.	n.d.	n.d.

Table 5. Chemical spoilage indicators; histamine (n=26).

Journal No.	Origin	Group	Species	Scientific name	Tissue	Histamine mg/kg w.w.
2019-1013/2	VNM	Limnic Fish	Clarias sp.	*Clarias* sp.	Filet	< 5
2019-156/1	LKA	Marine Fish	Malabar blood snapper	*Lutjanus malabaricus*	Filet	< 5
2019-975/2	VNM	Marine Fish	Indian Mackerel	*Rastrelliger kanagurta*	Filet	44
2019-157/1	LKA	Marine Fish	Narrow-barred Spanish mackerel	*Scomberomorus commerson*	Filet	< 5
2019-9/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	< 5
2019-10/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet/skin	< 5
2019-53/1	LKA	Marine Fish	Obtuse barracuda	*Sphyraena obtusata*	Filet	< 5
2019-275/1	THA	Marine Fish	Stolephorus spp.	*Stolephorus* spp.	Filet	< 5
2019-52/1	LKA	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	< 5
2019-63/1	MDV	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	< 5
2019-413/1	LKA	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	< 5
2019-506/1	VNM	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	< 5

Journal No.	Origin	Group	Species	Scientific name	Tissue	Histamine mg/kg w.w.
2019-348/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	< 5
2019-350/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	< 5
2019-355/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	< 5
2019-359/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	< 5
2019-361/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	< 5
2019-510/1	THA	Processed food	Seafood	*Rastrellinger kanagurta*	n.a.	< 5
2019-1094/1	THA	Processed food	Seafood	*Thunnus albacares*	n.a.	< 5
2019-343/1	THA	Processed food	Tuna based	n.a.	n.a.	< 5
2019-1091/1	MDV	Processed food	Tuna based	n.a.	n.a.	< 5
2019-1092/1	THA	Processed food	Tuna based	n.a.	n.a.	< 5
2019-1093/1	PHL	Processed food	Tuna based	n.a.	n.a.	8.6
2019-1096/1	THA	Processed food	Tuna based	n.a.	n.a.	< 5
2019-1097/1	PHL	Processed food	Tuna based	n.a.	n.a.	< 5
2019-1098/1	THA	Processed food	Tuna based	n.a.	n.a.	< 5

Table 6. Carbon monoxide, (n=2).

Journal No.	Origin	Category	Species	Scientific name	Tissue	Carbon monoxide (ng/g)
2019-52/1	Sri Lanka	Wild fish	Yellowfin tuna	*Thunnus albacares*	Fillet /Muscle	65
2019-63/1	Maledives	Wild fish	Yellowfin tuna	*Thunnus albacares*	Fillet /Muscle	20

Table 7. Elemental concentration of undesireable elments in mg/kg ww (n=116). Abbreviations: NHC = “Not for human consumption”, different maximum levels then apply.

Journal No.	Origin	Group	Product	Scientific name	Tissue	As	Cd	Hg	Pb
2019-1528/1	N.A.	Bivalves	Pacific oyster	*Crassostrea gigas*	Muscle	2.4	0.47	0.006	0.14

Journal No.	Origin	Group	Product	Scientific name	Tissue	As	Cd	Hg	Pb
2019-1012/1	VNM	Cephalopod	Dried baby cuttlefish (NHC)	*Sepiella japonica*	Muscle	0.72	0.53	0.009	0.041
2019-2009/2	VNM	Cephalopod	Purpleback squid	*Sthenoteuthis oualaniensis*	Muscle	5.7	0.42	0.014	0.006
2019-509/1	VNM	Crustacean	Brown crab	*Cancer pagurus*	White meat	21	0.014	0.06	0.007
2019-988/1	CAN	Crustacean	American lobster	*Homarus americanus*	White meat	9.7	0.12	0.12	< .004
2019-2184/1	CAN	Crustacean	American lobster	*Homarus americanus*	White meat	5.9	0.012	0.055	0.005
2019-639/2	CAN	Crustacean	Northern shrimp	*Pandalus borealis*	White meat	12	0.21	0.15	< .005
2019-20/2	CAN	Crustacean	Northern shrimp	*Pandalus borealis*	White meat	12	0.19	0.024	0.025
2019-715/1	RUS	Crustacean	Northern shrimp	*Pandalus borealis*	White meat	81	0.33	0.015	0.015
2019-1127/2	RUS	Crustacean	Northern shrimp	*Pandalus borealis*	White meat	700	0.33	0.12	0.041
2019-1128/2	RUS	Crustacean	Northern shrimp	*Pandalus borealis*	White meat	810	0.46	0.16	0.021
2019-1522/2	RUS	Crustacean	Northern shrimp	*Pandalus borealis*	White meat	100	0.056	0.031	< .005
2019-1527/1	CAN	Crustacean	Northern shrimp	*Pandalus borealis*	White meat	3.5	0.017	0.051	< .004
2019-638/1	VNM	Crustacean	Whiteleg shrimp	*Penaeus vannamei Boone*	White meat	0.39	0.0007	0.005	0.006
2019-974/1	VNM	Crustacean	Whiteleg shrimp	*Penaeus vannamei Boone*	White meat	0.32	0.003	0.008	< .005
2019-1635/1	VNM	Crustacean	Whiteleg shrimp	*Penaeus vannamei Boone*	White meat	0.79	< .0009	0.008	< .004
2019-2129/1	VNM	Crustacean	Whiteleg shrimp	*Penaeus vannamei Boone*	White meat	0.27	0.003	0.01	< .005
2019-14/1	ALB	Flour	Flour from prawns	*Pandalus borealis*	Flour	37	5.5	0.097	0.14
2019-1370/1	THA	Flour	Flour from prawns	*Acetes* sp.	Flour	9.5	0.31	0.021	0.12
2019-1013/2	VNM	Limnic Fish	Clarias sp.	*Clarias* sp.	Filet	0.94	< .001	0.029	< .005
2019-2131/1	CHN	Limnic Fish	Tilapia	*Sarotherodon galilaeus*	Filet	0.21	< .001	0.003	< .005
2019-1336/1	TWN	Marine Fish	Pacific saury	*Cololabis sira*	Filet	1	0.18	0.073	0.01
2019-1831/1	TWN	Marine Fish	Pacific saury	*Cololabis saira*	Filet	1.5	0.12	0.05	< .008
2019-2097/1	CHN	Marine Fish	Pacific Cod	*Gadus macrocephalus*	Filet	8.7	< .01	0.1	< .06

Journal No.	Origin	Group	Product	Scientific name	Tissue	As	Cd	Hg	Pb
2019-17/1	CHN	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	2.8	0.001	0.083	< .004
2019-252/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	1.8	< .001	0.019	< .005
2019-253/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	0.94	< .0009	0.043	< .004
2019-254/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	3.8	< .0009	0.024	< .005
2019-507/1	CHN	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	1.9	< .0007	0.028	< .004
2019-508/1	CHN	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	11	< .0009	0.029	< .004
2019-529/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	1.5	< .0009	0.093	0.009
2019-605/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	0.62	< .0009	0.017	< .004
2019-976/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	17	< .0008	0.064	< .004
2019-977/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	3.7	< .0009	0.026	< .004
2019-978/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	1.9	< .0009	0.016	< .005
2019-980/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	12	< .0009	0.03	< .005
2019-1525/1	CHN	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	0.63	0.0009	0.01	< .003
2019-1526/1	CHN	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	2.8	0.001	0.029	< .004
2019-1644/1	RUS	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	5.2	< .0009	0.032	< .005
2019-2094/1	CHN	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	3.2	< .0006	0.05	< .003
2019-2095/1	CHN	Marine Fish	Atlantic cod smoked	*Gadus morhua*	Filet	8.4	< .003	0.04	< .02
2019-2096/1	CHN	Marine Fish	Atlantic cod	*Gadus morhua*	Filet	4.1	< .0008	0.02	< .004
2019-19/1	CHN	Marine Fish	Pacific halibut	*Hippoglossus stenolepis*	Filet	1.2	< .001	0.08	< .005
2019-156/1	LKA	Marine Fish	Malabar blood snapper	*Lutjanus malabaricus*	Filet	0.3	0.001	0.079	< .005
2019-18/1	CHN	Marine Fish	blue grenadier	*Macruronus novaezelandiae*	Filet	0.66	0.001	0.36	< .004
2019-438/1	RUS	Marine Fish	Haddock	*Melanogrammus aeglefinus*	Filet	12	< .0009	0.047	0.006
2019-2132/1	VNM	Marine Fish	Striped catfish	*Pangasius hypophthalmus*	Filet	0.022	< .001	0.003	< .007

Journal No.	Origin	Group	Product	Scientific name	Tissue	As	Cd	Hg	Pb
2019-979/1	RUS	Marine Fish	Saithe	*Pollachius virens*	Filet	1.1	< .001	0.029	< .005
2019-1374/1	CHN	Marine Fish	Saithe	*Pollachius virens*	Filet	1.1	0.001	0.044	0.006
2019-2098/1	CHN	Marine Fish	Saithe	*Pollachius virens*	Filet	1.1	0.004	0.097	< .01
2019-975/2	VNM	Marine Fish	Indian Mackerel	*Rastrelliger kanagurta*	Filet	0.91	0.004	0.012	0.007
2019-1523/2	RUS	Marine Fish	Atlantic mackerel	*Scomber scombrus*	Filet	2.5	0.02	0.023	< .01
2019-157/1	LKA	Marine Fish	Narrow-barred Spanish mackerel	*Scomberomorus commerson*	Filet	1.8	0.001	0.18	< .006
2019-439/1	RUS	Marine Fish	Rose fish	*Sebastes norvegicus*	Filet	2.8	< .001	0.032	< .005
2019-9/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	0.47	< .002	0.042	< .01
2019-10/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	0.36	< .002	0.043	< .008
2019-2119/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	0.42	< .002	0.032	< .008
2019-53/1	LKA	Marine Fish	Obtuse barracuda	*Sphyraena obtusata*	Filet	2.3	0.005	0.78	< .005
2019-275/1	THA	Marine Fish	Stolephorus spp.	*Stolephorus spp.*	Filet	3.7	0.24*	0.027	0.065
2019-1524/1	CHN	Marine Fish	Alaska pollock	*Theragra chalcogramma*	Filet	0.81	< .01	0.012	< .06
2019-1529/1	CHN	Marine Fish	Alaska pollock	*Theragra chalcogramma*	Filet	4.2	0.004	0.11	< .003
2019-22/1	CHN	Marine fish	Alaska pollock	*Theragra chalcogramma*	Filet	0.89	0.004	0.038	< .004
2019-52/1	LKA	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	1.5	0.01	0.21	< .006
2019-63/1	MDV	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	1.4	0.008	0.4	< .005
2019-413/1	LKA	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	0.85	0.01	0.24	< .006
2019-506/1	VNM	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	0.65	0.009	0.25	< .005
2019-2116/1	LKA	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	1.5	0.009	0.2	< .006
2019-1616/1	VNM	Marine Fish	Tuna	n.a.	Filet	1	0.005	0.28	< .006
2019-1630/1	MUS	Marine Fish	Tuna	n.a.	Filet	0.95	0.012	0.27	< .006
2019-83/1	CHN	Oil	Oil	*Engraulis ringens*	Oil	0.041	0.023	< .005	0.1

Journal No.	Origin	Group	Product	Scientific name	Tissue	As	Cd	Hg	Pb
2019-662/1	PER	Oil	Oil	*Engraulis ringens*	Oil	7.4	< .005	< .005	< .02
2019-2312/1	MAR	Oil	Oil	*Engraulis ringens*	Oil	2.8	< .005	< .005	< .02
2019-2313/1	MAR	Oil	Oil	*Engraulis ringens*	Oil	5.5	< .005	< .005	< .02
2019-1050/1	MAR	Oil	Oil	n.a.	Oil	5.3	< .005	< .005	< .02
2019-1051/1	MAR	Oil	Oil	n.a.	Oil	5.3	< .004	< .004	< .02
2019-1531/1	CHN	Oil	Oil	n.a.	Oil	8.9	0.035	< .005	0.023
2019-1532/1	MAR	Oil	Oil	n.a.	Oil	0.017	< .003	< .003	< .02
2019-1614/1	PER	oil	Oil	n.a.	Oil	7.3	< .004	< .004	< .02
2019-2314/1	MAR	Oil	Oil	n.a.	Oil	2.8	< .004	< .004	< .02
2019-23/1	VNM	Processed food	Cod based	*Gadus morhua*	Swim bladder	0.17	0.017	0.029	0.025
2019-348/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	0.95	0.022	0.061	< .01
2019-350/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	1.2	0.018	0.033	< .006
2019-355/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	1.8	0.017	0.03	< .01
2019-359/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	0.45	0.015	0.039	0.013
2019-361/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	1	0.022	0.039	0.007
2019-21/1	MMR	Processed food	Seafood	*Macruronus novaezelandiae*	n.a.	0.74	0.004	0.043	< .01
2019-1622/1	VNM	Processed food	Seafood	*Penaeus Vannamei*	n.a.	0.25	0.002	0.003	0.007
2019-510/1	THA	Processed food	Seafood	*Rastrellinger kanagurta*	n.a.	0.96	0.007	0.007	0.009
2019-1094/1	THA	Processed food	Seafood	*Thunnus albacares*	n.a.	0.85	0.006	0.023	< .01
2019-16/1	THA	Processed food	Seafood	n.a.	n.a.	0.11	0.002	0.006	< .006
2019-177/1	VNM	Processed food	Seafood	n.a.	Swim bladder	0.27	0.015	0.034	0.044
2019-336/1	CHN	Processed food	Seafood	n.a.	n.a.	0.45	0.016	0.005	0.014
2019-337/1	MYS	Processed food	Seafood	n.a.	n.a.	0.71	0.058	0.009	< .008

Journal No.	Origin	Group	Product	Scientific name	Tissue	As	Cd	Hg	Pb
2019-1095/1	VNM	Processed food	Seafood	n.a.	n.a.	2.4	0.12	0.02	0.13
2019-1530/1	MYS	Processed food	Seafood	n.a.	n.a.	0.8	0.005	0.031	< .009
2019-1533/1	THA	Processed food	Seafood	n.a.	n.a.	0.086	0.002	0.005	< .006
2019-2130/1	THA	Processed food	Seafood	n.a.	n.a.	0.15	< .001	0.009	< .005
2019-2167/1	PHL	Processed food	Seafood	n.a.	n.a.	2.2	0.15	0.02	0.036
2019-2168/1	MAR	Processed food	Seafood	n.a.	n.a.	2.4	0.1	0.011	0.025
2019-2171/1	MAR	Processed food	Seafood	n.a.	n.a.	1.1	0.051	0.006	0.015
2019-2173/1	THA	Processed food	Seafood	n.a.	n.a.	0.95	0.037	0.009	0.3
2019-343/1	THA	Processed food	Tuna based	n.a.	n.a.	1	0.019	0.037	< .009
2019-1091/1	MDV	Processed food	Tuna based	n.a.	n.a.	0.65	0.034	0.15	< .005
2019-1092/1	THA	Processed food	Tuna based	n.a.	n.a.	0.68	0.02	0.051	< .005
2019-1093/1	PHL	Processed food	Tuna based	n.a.	n.a.	0.87	0.01	0.032	< .009
2019-1096/1	THA	Processed food	Tuna based	n.a.	n.a.	1.6	0.015	0.029	< .005
2019-1097/1	PHL	Processed food	Tuna based	n.a.	n.a.	1	0.038	0.1	< .005
2019-1098/1	THA	Processed food	Tuna based	n.a.	n.a.	0.88	0.017	0.056	< .005
2019-1375/1	THA	Processed food	Tuna based	n.a.	n.a.	1.1	0.022	0.096	< .004
2019-2136/1	VNM	Processed food	Tuna based	n.a.	n.a.	0.7	0.015	0.1	< .005
2019-2169/1	THA	Processed food	Tuna based	n.a.	n.a.	1	0.018	0.031	< .008
2019-2170/1	THA	Processed food	Tuna based	n.a.	n.a.	0.95	0.007	0.018	< .01
2019-2172/1	THA	Processed food	Tuna based	n.a.	n.a.	0.8	0.013	0.035	< .005
2019-2174/1	MUS	Processed food	Tuna based	n.a.	n.a.	1.2	0.028	0.08	< .009
2019-2175/1	THA	Processed food	Tuna based	n.a.	n.a.	0.71	0.01	0.053	< .005
2019-2177/1	PHL	Processed food	Tuna based	n.a.	n.a.	1	0.022	0.053	< .004

Journal No.	Origin	Group	Product	Scientific name	Tissue	As	Cd	Hg	Pb
	Maximum value					810	5.5	0.78	0.30
	Second largest value					700	0.53	0.4	0.14

*Average of two analytical measurements

Table 8. Dioxins and PCBs, n=31. Abbreviations: PCDD: Dioxins, PCDF: Furans, DL-PCBS: Dioxin like PCBs, NDL-PCBs: Non-Dioxin like PCBs. The analytical concentrations of 28 different compounds are summed as "Toxic Equivalence values" (TEQ-values) , to give three distinct (Upper bound) sum-parameters: Sum-PCDD+PCDF, sum DLPCBs and total TEQ sum. TEQ-values are provided in the pg/g (w/w) scale (pico-grams per gram in the naturally moist sample state). The indicator NDL-PCBs are provided as the upper bound sum of their analytical concentrations (Not TEQ-values), in the µg/kg (w/w) scale.

Journal No.	Origin	Product	Scientific name	Tissue	Sum DL-PCBs	PCDDs+ PCDFs	Total TEQ	Sum NDL-PCBs
2019-1012/1	VNM	Cephalopod	Baby Cuttlefish	*Sepiella japonica*	Muscle	0.011	0.16	0.17
2019-1013/2	VNM	Limnic Fish	Clarias sp.	*Clarias* sp.	Filet	0.090	0.15	0.24
2019-156/1	LKA	Marine Fish	Malabar blood snapper	*Lutjanus malabaricus*	Filet	0.074	0.09	0.17
2019-975/2	VNM	Marine Fish	Indian Mackerel	*Rastrelliger knagurta*	Filet	0.086	0.17	0.26
2019-157/1	LKA	Marine Fish	Narrow-barred Spanish mackerel	*Scomberomorus commerson*	Filet	0.20	0.14	0.33
2019-9/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	0.16	0.13	0.29
2019-10/1	AUS	Marine Fish	Yellowtail	*Seriola lalandi*	Filet	0.18	0.11	0.29
2019-53/1	LKA	Marine Fish	Obtuse barracuda	*Sphyraena obtusata*	Filet	0.094	0.08	0.17
2019-275/1	THA	Marine Fish	Stolephorus spp.	*Stolephorus spp.*	Filet	0.14	0.19	0.33
2019-52/1	LKA	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	0.013	0.03	0.04
2019-63/1	MDV	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	0.004	0.03	0.03
2019-413/1	LKA	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	0.007	0.03	0.04
2019-506/1	VNM	Marine Fish	Yellowfin tuna	*Thunnus albacares*	Filet	0.007	0.02	0.03
2019-662/1	PER	Oil	Oil	*Engraulis ringens*	Oil	0.761	0.47	1.23

Journal No.	Origin	Product	Scientific name	Tissue	Sum DL-PCBs	PCDDs+ PCDFs	Total TEQ	Sum NDL-PCBs
2019-1050/1	MAR	Oil	Oil	n.a.	Oil	0.85	0.38	1.23
2019-1051/1	MAR	Oil	Oil	n.a.	Oil	0.87	0.41	1.28
2019-348/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	0.012	0.05	0.07
2019-350/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	0.007	0.03	0.03
2019-355/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	0.018	0.15	0.17
2019-359/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	0.007	0.04	0.05
2019-361/1	THA	Processed food	Tuna based	*Katsuwonus pelamis*	n.a.	0.020	0.08	0.10
2019-510/1	THA	Processed food	Seafood	*Rastrellinger kanagurta*	n.a.	0.015	0.06	0.07
2019-1094/1	THA	Processed food	Seafood	*Thunnus albacares*	n.a.	0.024	0.20	0.22
2019-343/1	THA	Processed food	Tuna based	n.a.	n.a.	0.015	0.08	0.10
2019-1091/1	MDV	Processed food	Tuna based	n.a.	n.a.	0.005	0.03	0.04
2019-1092/1	THA	Processed food	Tuna based	n.a.	n.a.	0.009	0.03	0.04
2019-1093/1	PHL	Processed food	Tuna based	n.a.	n.a.	0.027	0.20	0.23
2019-1096/1	THA	Processed food	Tuna based	n.a.	n.a.	0.005	0.03	0.04
2019-1097/1	PHL	Processed food	Tuna based	n.a.	n.a.	0.003	0.02	0.03
2019-1098/1	THA	Processed food	Tuna based	n.a.	n.a.	0.005	0.03	0.03
2019-1375/1	THA	Processed food	Tuna based	n.a.	n.a.	0.014	0.05	0.06
	Maximum values				0.87	0.47	1.3	6.81
	Second largest value				0.85	0.41	1.2	6.1

Table 9. Selected Brominated Flame Retardants , PBDEs in µg/kg ww (n=31).

Journal No.	Origin	Species	Scient. Name	Tissue	PBDE-28	PBDE-47	PBDE-99	PBDE-100	PBDE-153	PBDE-154	PBDE-183	UB Sum 7-PBDE
2019-1012/1	VNM	Baby Cuttlefish	*Sepiella japonica*	Muscle	< .0005	0.0015	< .0008	< .0005	< .0008	< .0005	< .0033	0.01
2019-1013/2	VNM	Clarias sp.	*Clarias* sp.	Filet	< .0012	0.03	0.027	0.016	0.0086	0.015	< .0081	0.11
2019-156/1	LKA	Malabar blood snapper	*Lutjanus malabaricus*	Filet	< .0017	0.012	< .0028	0.0043	< .0028	0.0043	< .012	0.04
2019-975/2	VNM	Indian Mackerel	*Rastrelliger kanagurta*	Filet	< .0018	0.012	0.005	0.0043	< .003	0.0048	< .012	0.04
2019-157/1	LKA	Narrow-barred Spanish mackerel	*Scomberomorus commerson*	Filet	0.002	0.062	0.014	0.034	0.01	0.04	< .011	0.17
2019-9/1	AUS	Yellowtail	*Seriola lalandi*	Filet	0.0049	0.092	0.019	0.023	0.005	0.021	< .0081	0.17
2019-10/1	AUS	Yellowtail	*Seriola lalandi*	Filet	0.0056	0.16	0.048	0.045	0.0095	0.027	< .0072	0.30
2019-53/1	LKA	Obtuse barracuda	*Sphyraena obtusata*	Filet	0.0016	0.023	0.0039	0.012	0.0031	0.017	< .0081	0.07
2019-275/1	THA	Stolephorus spp.	*Stolephorus spp.*	Filet	< .0065	0.028	< .011	0.0098	< .011	0.011	< .046	0.12
2019-52/1	LKA	Yellowfin tuna	*Thunnus albacares*	Filet	< .00076	0.0017	< .0013	< .0008	< .001	< .0008	< .0053	0.01
2019-63/1	MDV	Yellowfin tuna	*Thunnus albacares*	Filet	< .0008	0.0025	< .0013	< .0008	< .0013	< .0008	< .0052	0.01
2019-413/1	LKA	Yellowfin tuna	*Thunnus albacares*	Filet	< .00081	0.00095	< .0014	< .0008	< .0014	< .0008	< .0057	0.01
2019-506/1	VNM	Yellowfin tuna	*Thunnus albacares*	Filet	< .0007	0.0012	< .0012	< .0007	< .0012	< .0007	< .0049	0.01
2019-662/1	PER	Oil	*Engraulis ringens*	Oil	0.081	6.3	0.13	1.8	< .043	0.62	< .18	9.00
2019-1050/1	MAR	Oil	n.a.	Oil	< .025	0.22	< .042	0.042	< .042	< .025	< .074	0.47
2019-1051/1	MAR	Oil	n.a.	Oil	< .024	0.21	0.05	0.041	< .04	0.024	< .071	0.46

Journal No.	Origin	Species	Scient. Name	Tissue	PBDE-28	PBDE-47	PBDE-99	PBDE-100	PBDE-153	PBDE-154	PBDE-183	UB Sum 7-PBDE
2019-348/1	THA	Tuna based	*Katsuwonus pelamis*	n.a.	< .0012	< .0012	< .0021	< .0012	< .0021	< .0012	< .0087	0.02
2019-350/1	THA	Tuna based	*Katsuwonus pelamis*	n.a.	< .00077	0.00082	< .0013	< .0008	< .0013	< .0008	< .0054	0.01
2019-355/1	THA	Tuna based	*Katsuwonus pelamis*	n.a.	< .0014	0.0055	0.017	0.007	0.0036	0.002	< .0096	0.05
2019-359/1	THA	Tuna based	*Katsuwonus pelamis*	n.a.	< .00098	0.0021	< .0017	< .001	< .0017	< .001	< .0068	0.02
2019-361/1	THA	Tuna based	*Katsuwonus pelamis*	n.a.	< .001	0.005	< .0017	< .001	< .0017	< .001	< .0071	0.02
2019-510/1	THA	Seafood	*Rastrellinger kanagurta*	n.a.	< .0016	0.0041	< .0026	< .0016	< .0026	< .0016	< .011	0.03
2019-1094/1	THA	Seafood	*Thunnus albacares*	n.a.	< .0041	0.0063	< .0071	< .0041	< .0071	< .0041	< .029	0.06
2019-343/1	THA	Tuna based	n.a.	n.a.	< .0011	0.0038	0.0055	< .0011	< .0018	< .0011	< .0074	0.02
2019-1091/1	MDV	Tuna based	n.a.	n.a.	< .00063	0.0016	< .0011	0.00079	< .0011	0.0012	< .0044	0.01
2019-1092/1	THA	Tuna based	n.a.	n.a.	< .00063	0.0015	< .0011	< .0006	< .0011	< .0006	< .0044	0.01
2019-1093/1	PHL	Tuna based	n.a.	n.a.	< .0077	0.017	< .013	< .0077	< .013	< .0077	< .054	0.12
2019-1096/1	THA	Tuna based	n.a.	n.a.	< .00062	0.00087	< .001	< .0006	< .001	< .0006	< .0043	0.01
2019-1097/1	PHL	Tuna based	n.a.	n.a.	< .00065	0.001	< .0011	< .0007	< .0011	< .0007	< .0045	0.01
2019-1098/1	THA	Tuna based	n.a.	n.a.	< .00067	0.0015	< .0011	< .0007	< .0011	< .0007	< .005	0.01

Journal No.	Origin	Species	Scient. Name	Tissue	PBDE-28	PBDE-47	PBDE-99	PBDE-100	PBDE-153	PBDE-154	PBDE-183	UB Sum 7-PBDE
2019-1375/1	THA	Tuna based	n.a.	n.a.	< .003	0.0044	< .0051	< .003	< .0051	< .003	< .021	0.01
			Maximum value		0.08	6.3	0.13	1.8	0.01	0.62	<LOQ	0.47
			Second largest value		0.006	0.22	0.05	0.05	0.01	0.04	-	0.46

Table 10. Selected PAH compounds in µg/kg ww (n=1).

Journal No.	Imported from	Group	Species	Scient. name	Tissue	BaP	LB Sum PAH_4
2019-2095/1	CHN	Smoked marine fish	Atlantic cod	*Gadus morhua*	Fillet	< .012	0.1

7 - ANNEX 2: Method performance data

Table 11. Summary of the 2019 chemical analytical methods of the Institute of Marine Research, Bergen, Norway

Compounds		Matrix	Method principle	Analytical method LOD in muscle (µg/kg w.w.)	Analytical method LOQ (µg/kg w.w.)	Level of action	Laboratory
Therapeutic agents and dyes	Chloramphenicol	Muscle	LC-MS/MS	0.25	-	Presence (MRPL=0.3)	IMR
	3-Amino-2-oxazolidinone (AOZ)	Muscle	LC-MS/MS	0.5	-	Presence (MRPL=1.0)	IMR
	1-Aminohydrantoin (AHD)	Muscle	LC-MS/MS	0.6	-	Presence (MRPL=1.0)	IMR
	3-Amino-5-morpholinomethyl-2-oxazolidinone (AMOZ)	Muscle	LC-MS/MS	0.4	-	Presence (MRPL=1.0)	IMR
	Semicarbazide (SEM)	Muscle	LC-MS/MS	0.5	-	Presence (MRPL=1.0)	IMR
	Malachite green (MG)	Muscle	LC-MS/MS	0.15	-	Presence (MRPL=2.0)	IMR
	Leuco malachite green (LMG)	Muscle	LC-MS/MS	0.15	-	Presence (MRPL=2.0)	IMR
	Crystal violet (CV)	Muscle	LC-MS/MS	0.15	-	Presence	IMR
	Leuco crystal violet (LCV)	Muscle	LC-MS/MS	0.15	-	Presence	IMR
	Brilliant green (BG)	Muscle	LC-MS/MS	0.15	-	Presence	IMR
POPs	PCDD and PCDF (dioxin and furan) congeners	Muscle	HRGC-HRMS	-	$2*10^{-5}$-0.02 ng/kg[1] TEQ	See annex 3	IMR
	non-orto PCB congeners	Muscle	HRGC-HRMS	-	$2*10^{-5}$-0.02 ng/kg[1] TEQ	See annex 3	IMR
	Mono-orto PCB congeners	Muscle	HRGC-MSMS	-	$2*10^{-5}$-0.02 ng/kg[1] TEQ	See annex 3	IMR
	NDLPCB congeners	Muscle	HRGC-MSMS	-	0.005-0.03	See annex 3	IMR
	PBDE-congeners	Muscle	HRGC-MSMS	-	0.0004-0.02	n.a.	IMR
	PAH	See annex 3	HRGC-MSMS	-	0.05-0.4	See Annex 3	IMR
Chemical elements	Pb	Muscle	ICPMS	-	4-20	See Annex 3	IMR
	Cd	Muscle	ICPMS	-	0.5-10	See Annex 3	IMR
	As	Muscle	ICPMS	-	10-80	See Annex 3	IMR
	Hg	Muscle	ICPMS	-	2-10	See Annex 3	IMR

Compounds		Matrix	Method principle	Analytical method LOD in muscle (µg/kg w.w.)	Analytical method LOQ (µg/kg w.w.)	Level of action	Laboratory
Indicators of spoilage	Histamine	Muscle	HPLC-UV	-	5 mg/kg	-	IMR

8 - ANNEX 3: Regulatory maximum levels

A selection of regulatory maximum levels for contaminants in seafood from on EU Commission regulation no 1881/2006

Element or pollutant	Unit of measure-ment	Marin Fish Fillet[1]	Some fish species Fillet[1]	Wild caught Eel Fillet[1]	Fresh water Fish Fillet[1]	Smoked seafood products	Fish liver	Crustaceans: White meat	Bivalves and smoked bivalves[2]	Cephalo-pods[3]	Marine Oils HC[4]
Arsenic (As)	mg/kg w.w.[6]	-		-	-	-	-	-	-	-	-
Cadmium (Cd)		0.05	0.1-0.25[8]	0.05	0.05	0.05-0.25[6,8]	-	0.5	1.0[6]	1.0	-
Mercury (Hg)		0.5	1.0	1.0	0.5	0.5[6,8]	0.5	0.5	0.5[6]	0.5	-
Lead (Pb)		0.3	0.3	0.3	0.3	0.3[6,8]	-	0.5	1.5[6]	0.3	-
Sum of dioxins and furans [5]	pg/g TEQ w.w. [6]	3.5	3.5	3.5	3.5	3.5[6,8]	-	3.5	3.5[6]	3.5	1.75
Sum of dioxin like PCBs [5]		-	-	-	-	-	-	-	-	-	-
Sum of dioxins. furans and dioxin like PCBs [5]		6.5	6.5	10	6.5	6.5[6,8]	20	6.5	6.5[6]	6.5	6
Sum of six NDLPCBs[5]	ng/g w.w.[6]	75	75	300	125	75[6,8]	200	75	75[6]	75	200
PAH Benzo[a]pyrene	µg/kg w.w. [6]	-	-	-	-	2-5[2,6,8]	-	-	5 (6)[2]	-	2
PAH $_4$, sum of 4 PAH compounds [7]	µg/kg w.w.[6]	-	-	-	-	12-30[2,6,8]	-	-	30 (35)[2]	-	10

Based on Commission regulation 1881/2006, Commission Regulation 1259/2011 amending Regulation 1881/2006 and Commission regulation (EU) 835/2011 amending Regulation 1881/2006.

- 1) When fish is intended to be eaten whole, the level should be applied to the whole product.
- 2) Value in brackets concerns smoked bivalves.
- 3) Without viscera.
- 4) HC = Human consumption pg/g fat
- 5) Upper bound sum calculation is assumed.
- 6) Wet weight (w.w.); the concentration in a naturally moist sample. Values for dried or otherwise processed food should be transformed to w.w.
- 7) Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene and chrysene, assuming a lower bound sum calculation.
- 8) Value change with different biological species

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