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قواعد الممارسات الخاصة بمنع وخفض التلوث بالدايوكسينات ومركبات ثنائية الفينيل عديدة الكلور المشابهة للدايوكسين في الأغذية والأعلاف

Code of Practice for the Prevention and reduction of Dioxin and Dioxin-like PCB contamination in food and feeds

هذه الوثيقة مشروع لمواصفة قياسية خليجية تم توزيعها لإبداء الرأي والملحوظات بشأنها، لذلك فإنها عرضة للتغيير والتبديل، ولا يجوز الرجوع إليها كمواصفة قياسية خليجية إلا بعد اعتمادها من الهيئة.

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Foreword

GCC Standardization Organization (GSO) is a regional Organization which consists of the National Standards Bodies of GCC member States. One of GSO main functions is to issue Gulf Standards /Technical regulations through specialized technical committees (TCs).

GSO through the technical program of committee TC No. (5) "Technical committee for standards of food and agriculture products" has asdoteds this Standard. The Draft Standard has been prepared by Saudi Arabia . The draft Standard has been prepared based on relevant ADMO, International and National foreign Standards and references.

This standard has been approved as a Gulf Standard by GSO Technical Council in its meeting No.(29), held on h( ).

GSO CAC DS 05

CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF DIOXIN AND DIOXIN-LIKE PCB CONTAMINATION IN FOODS AND FEEDS

INTRODUCTION

1. Dioxins, including polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) and dioxin-like polychlorinated biphenyls (DL-PCBs) and non-dioxine-like PCBs (ND-PCBs) are persistent organic pollutants(POPs) in the Environment ~~pervasive in the environment~~. Although dioxins and ~~dioxin-like PCBs~~ DL-PCBs show similarities in their toxicological and chemical behaviour, their sources are different. On the other hand while DL-PCBs and NDL-PCBs show a different toxicological behaviour, their sources are similar or the same. The NDL-PCBs account for the majority of the total PCB contamination, the remainder being DL-PCBs.

2. Current sources of dioxins and ~~dioxin-like~~ PCBs entering the food chain include new emissions and remobilisation of deposits or reservoirs in the environment. New emissions are mainly via the air route. ~~Dioxins and dioxin-like~~ PCBs decompose very slowly in the environment and remain there for very long periods of time. Therefore, a large part of current exposure is due to releases of dioxin and ~~dioxin-like~~ PCBs that occurred in the past.
3. PCBs~~, including dioxin-like PCBs,~~ were produced intentionally and in considerable amounts between the 1930s and 1970s and were used in a wide range of applications. PCBs are still in use in existing closed systems and contained in solid matrices (e.g., sealing materials and electrical capacitors). Certain commercial PCBs are known to be contaminated with PCDFs and could therefore be regarded as a potential source for dioxin contamination.
4. Today release of ~~dioxin-like~~ PCBs occurs from leakages, accidental spills and illegal disposal and through emissions via air from thermal processes. ~~Migration from sealants and other old matrix applications are of minor importance. The remobilisation of dioxin-like PCBs from environmental reservoirs is similar to dioxins~~ The emission of PCBs from paints and/or sealants into the environment e. g. during demolition and reconstruction of older buildings appears to be of some importance as a source.

5. Dioxins are formed as unwanted by-products from a number of human activities including certain industrial processes (e.g., production of chemicals, metallurgical industry) and combustion processes (e.g., waste incineration). Accidents at chemical factories have been shown to result in high emissions and contamination of local areas. Other dioxin sources include domestic furnaces as well as ~~heaters,~~ agricultural and backyard burning of harvest residue and backyard burning of household wastes. Natural processes such as volcanic eruptions and forest fires can also produce dioxins.

6. When released into the air, dioxins can deposit locally on plants and on soil, consequently contaminating both food and feed. Dioxins can also be widely distributed by long-range atmospheric transport. The amount of deposition varies with proximity to the source, plant species, weather conditions and other specific conditions (e.g. altitude, latitude, temperature).
7. Sources of dioxins in soil include deposition from atmospheric dioxins, application of contaminated sewage sludge to farm land, flooding of pastures with contaminated sludge, and prior use of contaminated pesticides (e.g., 2.4.5-trichlorophenoxy acetic acid) and fertilizers (e.g., certain compost). Other sources of dioxins in soil may be of natural origin (e.g., ball clay).
8. Dioxins and ~~dioxin-like~~ PCBs are poorly soluble in water. However, they are adsorbed onto mineral and organic particles suspended in water. The surfaces of oceans, lakes and rivers are exposed to aerial deposition of these compounds which are consequently concentrated along the aquatic food chain. The entry of waste water or contaminated effluents from certain processes, such as chlorine bleaching of paper or pulp or metallurgical processes, can lead to contamination of water and sediment of coastal ocean areas, lakes and rivers.
9. The uptake of dioxins and ~~dioxin-like~~ PCBs by fish occurs via gills and diet. Fish accumulate dioxins and ~~dioxin-like~~ PCBs in their fatty tissue and liver. Bottom dwelling/bottom feeding fish species are more exposed to contaminated sediments than pelagic fish species. However, levels of dioxins and ~~dioxin-like~~ PCBs in bottom dwelling/bottom feeding fish are not always higher than those in pelagic fish depending on the size, diet and physiological characteristics of the fish. ~~In general, fish show an age-dependent accumulation of dioxins and dioxin-like~~ PCBs. Other factors that may affect accumulation of dioxins and PCBs in fish include age, weight, lipid content or environmental status of their environment.

10. Food of animal origin is the predominant route of human exposure to dioxins and ~~dioxin-like~~ PCBs with approximately 80–90% of the total exposure via fats in fish, meat and dairy products. Levels of dioxins and ~~dioxin-like~~ PCBs in animal fat may be related to contamination of the local environment and to contamination of feed (e.g., fish-oil and fish-meal) or, to certain production processes (e.g., artificial drying
11. The Joint FAO/WHO Expert Committee on Food Additives (JECFA) ~~and the European Union Scientific Committee on Food (EU SCF) derived tolerable intakes and compared these with calculated intakes. They concluded that a considerable proportion of the population may exceed the tolerable intake of dioxins and dioxin-like PCBs.~~ assessed at its 57th meeting in 2002 the toxicity of dioxins and DL-PCBs. The long half-lives of dioxins and DL-PCBs mean that each daily ingestion has a small or even a negligible effect on overall body burden. In order to assess long- or short-term risks to health due to these substances, total or average intake should be assessed over months, and tolerable intake should be assessed over a period of at least 1 month. To encourage this view, the JECFA decided to express the tolerable intake as a monthly

value in the form of a provisional tolerable monthly intake (PTMI). A PTMI of 70 pg/kg bw per month for dioxins and DL-PCBs expressed as Toxic Equivalent Factors (TEFs) was derived. JECFA concluded that despite the uncertainties, the intake estimates suggest that a considerable fraction of the population has a long-term mean intake above the PTMI.

12. JECFA assessed at its 80th meeting in 2015 the toxicity of NDL-PCBs. JECFA concluded that none of the available studies on the six indicator PCBs (PCB 28, PCB 52, PCB 101, PCB 138, PCB 153 and PCB 180) and PCB 128 were suitable for derivation of health-based guidance values or for assessment of the relative potency of the NDL-PCBs compared with a reference compound. Therefore, a comparative approach using the minimal effect doses was developed in order to estimate Margins of Exposure (MOEs) to provide guidance on human health risk

13. JECFA concluded that dietary exposures to NDL-PCBs are unlikely to be of health concern for adults and children, based on the available data. Although the MOEs are lower for breastfed infants, based on current knowledge, the benefits of breastfeeding are considered to outweigh the potential disadvantages that may be associated with the presence of NDL-PCBs in breast milk

14. In order to reduce the contamination of food, control measures at the feed level should be considered. These may involve developing Good Agricultural Practice, Good Animal Feeding Practice (~~see Codex Alimentarius Commission: Code of Practice on Good Animal Feeding~~ see *Code of Practice on Good Animal Feeding* (CXC 54-2004)), and Good Manufacturing Practice guidance and measures to effectively reduce dioxins and ~~dioxin-like~~ PCBs in feed, including:

    - Identification of agricultural areas with increased dioxin and ~~dioxin-like~~ PCB contamination due to local emission, accidents or illegal disposal of contaminated materials, and monitoring of feed and feed ingredients derived from these areas,

    - Monitoring of dioxin and PCB content of sewage sludge and compost used as fertilizers in agriculture, as well as its compliance with nationally established guideline or maximum levels.

    - ~~Setting guidance values for soil~~ Establishing and recommendation for special agricultural use (e.g., limitation of grazing or use of appropriate agricultural techniques).
    - Identification of possibly contaminated feed and feed ingredients.
    - Monitoring compliance with nationally-established guideline levels or maximum limits, if available, and minimizing or decontaminating (e.g., refining of fish oil) non-complying feed and feed ingredients.

– Identification and control of critical feed manufacturing processes (e.g., artificial drying by direct heating).

15. Similar control measures, where applicable, should be considered for reducing dioxins and ~~dioxin-like~~ PCBs in food.

16. Dioxins and PCBs accumulate in tissues of food-producing animals, including fish. In addition, they can be excreted in fat-containing products such as milk and eggs. There are clear differences in toxicokinetic behaviour between the various dioxin and PCB congeners.

17. For most farm animal species existing studies have shown that dioxins and PCBs are accumulated in body fat and liver, but also excreted into eggs and milk. This excretion contributes to lower accumulation in the body, and decreased levels after termination of the exposure. In growing animals the increase in body fat mass is also an important factor in the tissue levels obtained during exposure, which decreases after termination of the exposure.

18. Factors related to the kinetics of contaminants in the animal may be described by factors like the

    • transfer rates (TRs) describing the percentage of the ingested contaminant that is excreted in milk or eggs or

    • bioconcentration factor (BCF), describing the ratio between the level in tissues, milk or eggs, and that in the feed. BCFs are more suitable for tissues, since it is more difficult to obtain the information on the total weight of muscle or adipose tissues in the animal required to calculate the TRs.

19. TRs and BCFs differ for each congener but in practice those for the lower chlorinated and more persistent congeners are more relevant because they contribute most to TEQ, like PeCDD 2,3,4,7,8-PeCDF, TCDD, TCDF (in the case of chickens) and to a lesser extent the hexachlorinated PCDD/Fs. Only in some cases, like where pentachlorophenol (PCP) is the contamination source, will higher chlorinated congeners like HpCDD make a significant contribution to the toxic equivalency (TEQ) level. In the case of DL-PCBs, PCB-126 and to some extent PCB-169 are the most relevant congeners in terms of contribution to the TEQ levels.

20. PCDD/Fs and PCBs are accumulated to a greater extent in fillet of oily fish (such as salmon and trout) than leaner fish, the latter having higher concentrations of these compounds in the liver tissue. The main feed-related sources of dioxins and DL-PCBs in farmed fish are often fish oil and fishmeal. In addition to the feed composition, the transfer of dioxins and PCBs to fillets depends on other factors such as species, and animal growth and levels of dioxins and DL-PCBs in the environment (water and sediment).

Source directed measures

21. Reducing sources of dioxins and ~~dioxin-like~~ PCBs is an essential prerequisite for a ~~further~~ reduction of contamination. Measures to reduce dioxin emission sources should be directed to reducing the formation of dioxin during thermal processes as well as the application of destruction techniques. Measures to reduce ~~dioxin-like~~ PCBs emission sources should be directed to minimizing releases from existing equipment

(e.g. transformers, capacitors), prevention of accidents and better control of the disposal of ~~dioxin-like~~ PCBs containing oils and wastes.

22. The Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention) is a global treaty to protect human health and the environment from persistent organic pollutants (POPs) including dioxins and ~~dioxin-like~~ PCBs. it includes a number of possible source-directed measures that national authorities can consider.

23. Part II of Annex A of the Stockholm Convention lists the following priority measures: ~~industrial source categories, that have the potential for comparatively high formation and release of dioxins, and dioxin-like PCBs to the environment.~~

(a) with regard to the elimination of the use of PCBs in equipment (e.g. transformers, capacitors or other receptacles containing liquid stocks) by 2025:
(i) identify, label and remove from use equipment containing greater than 10% PCBs and volumes greater than 5 litres;
(ii) identify, label and remove from use equipment containing greater than 0.05% PCBs and volumes greater than 5 litres;
(iii) Endeavour to identify and remove from use equipment containing greater than 0.005% PCBs and volumes greater than 0.05 litres;

(b) consistent with the priority measures under a), to reduce exposures and risk to control the use of PCBs:
(i) Use only with intact and non-leaking equipment and only in areas where the risk from environmental release can be minimised and quickly remediated;
(ii) Do not use in equipment in areas associated with the production or processing of food or feed;
(iii) When used in populated areas, including schools and hospitals, all reasonable measures to protect from electrical failure which could result in a fire, and regular inspection of equipment for leaks;

(c) that equipment containing PCBs, as described under a) shall not be exported or imported except for the purpose of environmentally sound waste management;
(d) Except for maintenance and servicing operations, not allow recovery for the purpose of reuse in other equipment of liquids with polychlorinated biphenyls content above 0.005% Ensure environmentally sound waste management of liquids containing PCBs and equipment contaminated with PCBs having a PCB content above 0.005%, as soon as possible but no later than 2028.
(f) Identify other articles containing more than 0.005% PCBs (e.g. cable-sheaths, cured caulk and painted objects) and manage them in an environmentally sound manner.

24. Part II of Annex C lists the following industrial source categories, that have the potential for comparatively high formation and release of dioxins and PCBs to the environment

a) Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge;

b) Cement kilns firing hazardous waste;

c) Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching;

d) Thermal processes in the metallurgical industry, i.e. secondary copper production; sinter plants in the iron and steel industry; secondary aluminium production; secondary zinc production

25. Part III of Annex C also lists the following source categories that may unintentionally form and release dioxins, and ~~dioxin-like~~ PCBs, to the environment:

    a) Open burning of waste, including burning of landfill sites;

    b)Thermal processes in the metallurgic industry not mentioned in Part II,Annex C;

    c) Residential combustion sources;

    d) Fossil fuel-fired utility and industrial boilers;

    e) Firing installations for wood and other biomass fuels;

    f) Specific chemical production processes releasing unintentionally formed ~~persistent organic pollutants~~ POPs, especially production of chlorophenols and chloranil;

    g) Crematoria;

    h) Motor vehicles, particularly those burning leaded gasoline;

    i) Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction);

    j) Shredder plants for the treatment of end of life vehicles;

    k) Smouldering of copper cables;

    l) Waste of oil refineries.

26. Adopting technologies to minimize formation and release of dioxins and ~~dioxin-like~~ PCBs from these sources categories ~~should~~ can be considered by national authorities when developing national measures to reduce dioxin, ~~and~~ ~~dioxin-like~~ DL-PCBs and NDL-PCBs

27. Other possible sources of PCB contamination in food and feed that authorities may consider addressing include intake of contaminated soil (free ranging laying hens, flooded land, burned areas), waste oil (transmission oil leakage, using waste oil in paints), sisal (bags, binding twine), tyres used as feeding troughs or plaything in animal enclosures, applications of PCB-containing paints or coatings and releases from caulk.

Scope

28. This Code of Practice focuses on measures (e.g., Good Agricultural Practices, Good Manufacturing Practices, Good Storage Practices, Good Animal Feeding Practices, and Good Laboratory Practices) for national authorities, farmers, and feed and food manufacturers as well as consumers to prevent or reduce dioxin and ~~dioxin-like~~ PCB contamination in foods and feeds.
29. This Code of Practice applies to the production and use of all materials destined for feed (including grazing or free-range feeding, forage crop production and aquaculture) and food at all levels whether produced industrially, on farm or in household.
30. Since the global limitation and reduction of dioxins and PCBs from non food / feed related industrial and environmental sources may lie outside of the responsibility of CCCF, these measures will not be considered within this Code of Practice.

~~**Normative references**~~

~~GSO 2216: Good Agricultural Practices Part1Fruit and vegetables.~~

~~GSO 2215: Good Agricultural Practices Part2Farm.~~

RECOMMENDED PRACTICES BASED ON

GOOD AGRICULTURAL PRACTICES (GAPs),

GOOD MANUFACTURING PRACTICES (GMPs),

GOOD STORAGE PRACTICES (GSPs), GOOD ANIMAL FEEDING PRACTICES (GAFPs), AND GOOD LABORATORY PRACTICES (GLPs)

Control measures within the food chain

Air, Soil, Water

31. To reduce dioxin and ~~dioxin-like~~ PCB contamination in the air, national food authorities should consider recommending to their national authorities responsible for air pollution measures to ~~prevent~~ restrict uncontrolled burning of wastes, including the burning of landfill sites or backyard burning, and the use of PCB treated wood for domestic heaters.
32. Control measures to prevent or reduce contamination of the environment by dioxins and ~~dioxin-like~~ PCBs are important. To reduce possible contamination of feed or food, agricultural land with unacceptable dioxin and ~~dioxin-like~~ PCBs contamination due to local emission, accidents, or illegal disposal of contaminated materials should be identified.
33. Agricultural production on contaminated areas should be avoided or should be restricted if a significant transfer of dioxins and ~~dioxin- like~~ PCBs to feed or food produced on these areas is anticipated. ~~If possible, contaminated soil should be treated and detoxified or removed and stored under environmentally sound conditions.~~
34. The spreading of sewage sludge contaminated with dioxins and ~~dioxin-like~~ PCBs can lead to adhering of ~~contaminants on the~~ to vegetation which can increase livestock exposure. Sewage sludge used in agriculture should be monitored, as necessary, for dioxins and ~~dioxin-like~~ PCBs and treated, as necessary, ~~to render it inert or to detoxify it.~~ National guidelines should be adhered to where applicable.

35. Livestock, game, and poultry, exposed to contaminated soil, may accumulate dioxins and ~~dioxin-like~~ PCBs by consumption of contaminated soil or plants. These areas should be identified and access by certain food producing animal controlled. If necessary, the outdoor production in these areas should be restricted.

36. Source-reduction measures ~~will~~ may take many years to reduce contamination levels in wild ~~caught~~ fish due to the long half-lives of dioxins and ~~dioxin-like~~ PCBs in the environment.

    To reduce exposure to dioxins and ~~dioxin-like~~ PCBs, highly contaminated areas (e.g., lakes and rivers or contaminated marine catching areas) and relevant fish species should be identified and fishing in these areas should be controlled and, if necessary, restricted

Feed

37. The bulk of human dietary intake of dioxins and ~~dioxin-like~~ PCBs is due to the ~~deposition~~ concentration of these substances in the lipid component of animal derived foods (e.g., poultry, fish, eggs, meat and milk). In lactating animals dioxins and ~~dioxin-like~~ PCBs are excreted ~~partly~~ with milk fat, and in laying hens they may concentrate ~~the contaminants are concentrated~~ in the fat content of the ~~in laid~~ of the egg yolk. To reduce this transfer, control measures at the feed and feed ingredients level should be considered. Measures to reduce the dioxin and ~~dioxin-like~~ PCB levels in feed would have an ~~immediate~~ rapid effect on their ~~contaminant levels~~ concentration in food of animal origin originating from farm animals, including farmed fish. ~~These~~ Such measures include: ~~should involve developing Codes of Good Agricultural Practices, Good Animal Feeding Practices (see, Good Manufacturing Practices, Good Storage Practices, and other control measures e.g., HACCP-like principles) which may reduce levels of dioxins and dioxin-like PCBs. Such measures may include:~~

- identification of possibly contaminated areas in the feed supply ecosystem,
- identification of the origin of frequently contaminated feed or feed ingredients, and
- monitoring the compliance of feed and feed ingredients with nationally-established guideline levels or maximum limits, if available. ~~Threshold violating commodities should be investigated by the competent national authority, to determine whether those commodities should be excluded from further feeding~~.

38. ~~Competent~~ National authorities should periodically sample and analyse suspect feed and feed ingredients , using recognized international methods, ~~suspect feed and feed ingredients~~ to verify dioxin and ~~dioxin-like~~ PCB levels. This information will determine actions, if needed, to minimize dioxin and ~~dioxin-like~~ PCB levels and allow alternative feed and feed ingredients to be located, if necessary.

39. The purchaser and user should pay attention to and request guarantees from their supplier as regards

    A) origin of feed and feed ingredients to ensure that producers and/or companies have certified production facilities, production processes and quality assurance programmes (e.g., HACCP-like principles);

B) accompanying documents confirming compliance with nationally-established guideline levels or maximum limits, if available, according to national requirements.

Feed of animal origin

40. Due to the position of their precursors in the food chain, animal derived feed has a higher risk for dioxin and ~~dioxin-like~~ PCB contamination compared to plant derived feed. Attention should be paid to avoid dioxins and ~~dioxin-like~~ PCBs ~~these contaminants~~ from entering the food chain through the feeding of animal derived feed to food producing animals. Animal derived feed should be monitored, as necessary, for dioxins and ~~dioxin-like~~ PCBs. ~~Accumulation of dioxins and dioxin-like PCBs in adipose tissues of livestock, with possible resultant violations of nationally-established guideline levels or maximum limits, if available, for meat and milk or their derived products should be prevented. Therefore,~~ feed of animal origin that exceeds nationally-established guideline levels or maximum limits, if available, or contains elevated levels of dioxins or ~~dioxin-like~~ PCBs should not be fed to animals unless the fat has been removed.

41. If intended for use in feed, fish-oil and other products derived from fish, ~~milk and milk substitutes, and~~ or animal fats should be monitored to the extent practicable for dioxins and ~~dioxin-like~~ PCBs. If there are nationally-established guideline levels or maximum ~~limits~~ levels, the feed manufacturer should ensure that the products are in compliance with these provisions.

Feed of plant origin

42. If potential sources of dioxins and ~~dioxin-like~~ PCBs are anticipated in the vicinity of fields, attention should be paid to monitor these areas, as necessary.

43. Cultivation sites irrigated with water or treated with sewage sludge or municipal compost that may contain elevated dioxin and ~~dioxin-like~~ PCB levels should be monitored, as necessary, for contamination.

44. Prior treatment of ~~crops~~ fields with herbicides from the chlorinated phenoxyalkanoic acid type or chlorinated products like pentachlorophenol should be considered as a potential source for dioxin contamination. Dioxin levels in soil and forage plants from sites treated previously with dioxin-contaminated herbicides should be monitored as necessary. This ~~information~~ will enable ~~competent~~ national authorities ~~if necessary,~~ to take appropriate management measures in order to prevent the transfer of dioxins ~~(and dioxin-like~~ PCBs) ~~into~~ to the food chain.

45. Typically, oilseeds and vegetable oil are not significantly contaminated with dioxins and ~~dioxin-like~~ PCBs. This also applies to other by-products of oilseed processing (e.g., oilseed cakes) used as feed ingredients. However, certain vegetable and animal oil refining by-products (e.g., fatty acid distillates and deodistillates) and spent products used in oil refining (e.g. bleaching clays) may contain increased levels of dioxins and ~~dioxin-like~~ PCBs and should be analysed, as necessary, if used for feed.

Feed and food processing

Drying processes

46. Certain processes for the artificial drying of feed and food (and feed or food ingredients) and the heating of indoor growing facilities (e.g. ~~hothouses~~ greenhouses) requires a flow of heated gases, either a flue gas-air mix (direct drying or heating) or heated air alone (indirect drying or heating). Accordingly, fuels not expected to generate ~~which are not generating~~ dioxins and dioxin-like compounds ~~and other harmful contaminants at unacceptable levels~~ should be used. Feed, food and feed or food ingredients that are dried or subjected to heated air should be monitored as necessary to ensure that drying or heating processes do not result in elevated levels of dioxins and ~~dioxin-like~~ PCBs.

47. The quality of commercial dried feed materials, in particular green fodder and commercially dried foods depends on the selection of the raw material and the drying process. The purchaser should consider requiring a certificate from the manufacturer/supplier, confirming that the dried goods are produced ~~according to~~ applying Good Manufacturing Practice, ~~especially~~ particularly in the choice of the fuel uses for drying or heating and are in compliance with nationally-established guideline levels or maximum limits, if available.

Smoking

48. Depending on the technology used, smoking can be a critical processing step for increased dioxin content in foods, especially if the products show a very dark. surface with particles of soot. Such processed products should be monitored for dioxin and PCBs, as necessary, by the manufacturer.

Milling / Disposal of contaminated milling fractions

49. ~~In agricultural land in the vicinity of dioxin and dioxin-like PCB emission sources, the~~ Airborne external deposition of dioxins and ~~dioxin-like~~ PCBs on the surface of all parts of the grain plants as well as the adherent dust fraction from the standing crop is widely removed during the milling process and before the final grinding process. If present, most particle-bound contamination is removed in the loading chute with the remaining dust. Further external dioxin and ~~dioxin-like~~ PCB contaminations are significantly reduced during aspiration and sieving. Certain grain fractions, especially dust, chaff and mixed screenings, can have increased dioxin and ~~dioxin-like~~ PCB levels and should be monitored, as necessary. If there is evidence ~~for~~ of elevated contamination, such fractions should not be used in food or feed and should be treated as waste.

Food preparation

50. **Food selection and preparation can reduce exposure to dioxins and PCBs**

51. Food preparation such as skinning, trimming the fat, in addition to the disposing of pan drippings and poaching/boiling liquids) are practical approaches to reduce exposure to dioxins and PCBs. Although removal of fat can reduce dioxin and PCB levels significantly, such practices also reduce fat-soluble nutrients and other beneficial compounds (such as the long-chain-3 polyunsaturated fatty acid). Therefore, it is essential to carefully consider both risks and benefits in any public health message regarding food consumption.

Substances added to feed and food

Minerals and trace elements

52. Some minerals and trace elements are obtained from natural sources. However, experience has shown, that geogenic dioxins may be present in certain prehistoric sediments. Therefore, dioxin levels in minerals and trace elements added to feed or food should be monitored as necessary.

53. Reclaimed mineral products or by-products from certain industrial processes may contain elevated levels of dioxins and ~~dioxin-like~~ PCBs. The user of such feed ingredients should verify that dioxin and ~~dioxin-like~~ PCBs are within nationally-established guideline levels or maximum limits, if available, through certification by the manufacturer or supplier.

54. Elevated levels of dioxins have been found in ball clay used as an anticaking agent in soybean meal in feed. Attention should be paid to minerals used as binders or anticaking agents (e.g., bentonite, montmorillonite, kaolinitic clay, diatomaceous earth) and carriers (e.g., calcium carbonate) used as feed ingredients. As assurance to the user that these substances do not contain minerals with elevated levels (e.g., exceeding nationally- established guideline levels or maximum limits, if available) of dioxins and ~~dioxin-like~~ PCBs, the distributor should provide appropriate certification to the user of such feed ingredients.

55. ~~The supplementation of~~ Feed of some food producing animals with trace elements (e.g., copper or zinc) ~~depends on the species, age and performance~~. Minerals, including trace elements, which are by-products or co-products of industrial metal production have been shown to contain elevated levels of dioxins. Such products should be monitored for dioxins and ~~dioxin-like~~ PCBs, as necessary.

Ingredients

56. Feed and food manufacturers should ensure that all ingredients in feed and food ~~have minimal levels of to reduce possible contamination and to~~ comply with nationally-established guideline levels or maximum limits dioxins and PCBs, if available.

Harvesting, transport, storage of feed and food

57. To the extent feasible, it should be ensured that minimal contamination with dioxins and ~~dioxin-like~~ PCBs occurs during the harvest of feed and food. This can be achieved in possibly contaminated areas by minimizing soil deposition on feed and food during harvest by using appropriate techniques and tools according to Good Agricultural Practice. Roots and tubers, grown on contaminated soil, should be washed to reduce soil contamination. If roots and tubers are washed, they should be sufficiently dried before storage or be stored following techniques (e.g. ensilage) aiming to prevent mould formation.

~~58.~~ After flooding, crops harvested for feed and food should be monitored~~, as necessary,~~ for dioxins and ~~dioxin-like~~ PCB, if there is evidence of dioxins and/or ~~dioxin-like~~ PCBs contamination in flood water ~~contamination by these contaminants.~~

59. To avoid cross-contamination, the transport of feed and food should only be performed in vehicles (including ships) ~~or~~ that are free of dioxins and ~~dioxin-like~~ PCBs ~~in containers not contaminated with~~. Storage containers for feed and food should be painted only with dioxin and ~~dioxin-like~~ PCB-free paint.

60. Storage sites for feed or food should be free from ~~contamination with~~ dioxins and ~~dioxin-like~~ PCBs. Surfaces (e.g., walls, floors) treated with tar-based paints may result in transfer of dioxins and dioxin-like PCBs to food and feed. Surfaces that come in contact with smoke and soot from fires always bear a risk of contamination with dioxins and dioxin-like PCBs. These sites should be monitored as necessary for contamination before use for storage of feed and food.

Special problems of animal keeping (Housing)

61. Food producing animals may be exposed to dioxins and dioxin-like PCBs found in certain treated wood used in buildings, farm equipment and bedding material. To reduce exposure, animal contact with treated wood containing dioxins and ~~dioxin-like~~ PCBs should be minimized. In addition, sawdust from treated wood containing dioxins and ~~dioxin-like~~ PCBs should not be used as bedding material.

62. Due to the potential for soil contamination ~~in certain soil~~, eggs from free living or free-range hens (e.g., organic farming) may have ~~elevated levels~~ higher levels of dioxins and ~~dioxin-like~~ PCBs compared to eggs from caged hens and should be monitored, as necessary.

63. Attention should be paid to older buildings as they may have building materials and varnishes that may contain dioxin and ~~dioxin-like~~ PCBs. If they have caught fire, measures should be taken to avoid contamination of the feed and feed chain by dioxins and ~~dioxin-like~~ PCBs.

64. In housings without a floor covering, the animals normally ~~will~~ may take up soil particles from the ground. If there are indications of increased levels of dioxins and ~~dioxin-like~~ PCBs, the contamination of the soil should be controlled as necessary. If needed, the soil should be exchanged.

65. Pentachlorophenol-treated wood in animal facilities has been associated with elevated levels of dioxins in beef. Wood (e.g., railroad ties, utility poles) treated with chemicals such as pentachlorophenol or other unsuitable ~~materials~~ substances should not be used as fence posts for enclosures of free-range animals ~~or feed lines, unless allowed by national authorities or feed lines.~~ Hay racks should not be constructed from such treated wood. In addition, the preservation of wood with waste oils should also be avoided.

Monitoring

66. Farmers and industrial feed and food manufacturers have the primary responsibility for feed and food safety. Testing could be conducted within the framework of a food safety programme (e.g. Good Manufacturing Practices, On-Farm Safety programmes, Hazard Analysis and Critical Control Point programmes, etc.) In previous sections of this Code, it is mentioned where it could be appropriate to perform monitoring. Competent authorities should enforce the primary responsibility of farmers, feed and food manufacturers for feed and food safety through the operation of surveillance and control systems at appropriate points throughout the food chain, from the primary production to the retail level. In addition competent authorities should establish their ~~set up~~ own monitoring programmes.

67. As analyses for dioxins are relatively ~~quite~~ expensive ~~in comparison to determination of other chemical contaminants~~, periodic tests should be performed to the extent feasible at least

by industrial feed and food manufacturers including both incoming raw materials and final products and data should be kept **(see paragraph 77).**The frequency of sampling should consider results from previous analysis (by individual companies and/or via a pool of industry results within the same sector). If there are indications of elevated levels of dioxins and ~~dioxin-like~~ PCBs, farmers and other primary producers should be informed about the contamination and the source should be identified. and the necessary measures taken to remediate the situation and reduce or prevent further contamination.

68. Monitoring programmes dealing with contaminations originating from the environment, accidents or illegal disposals should be organized by operators in the feed and food chain and by ~~to the extent feasible and~~ competent national authorities in order to obtain additional information on food and feed contamination. Products or ingredients at risk or found with elevated contamination should be monitored more intensively. For example, monitoring programmes may include major fish species used in food or feed that have been shown to contain elevated levels of dioxins and ~~dioxin-like~~ PCBs.

Sampling, analytical methods, data reporting and laboratories

69. Advice concerning analytical requirements and qualification of laboratories is given in the literature.

70. ~~These recommendations and conclusions form the basis of the evaluation by JECFA and others. Furthermore, consideration of methods of analysis of dioxins and dioxin-like PCBs is addressed by the Codex Committee of Methods of Analysis and Sampling.~~ Traditional methods for the analysis of dioxin and ~~dioxin-like~~ DL- PCBs rely on gas chromatography coupled to high-resolution mass spectrometry (GC-HRMS) which is time-consuming and expensive. Methods based on gas chromatography coupled to tandem mass spectrometry (GC-MS/MS) can also be used to quantify dioxins and DL-PCBs .Alternatively, bioassay techniques have been developed as high throughput screening methods which can be less expensive than traditional methods. However, the cost of analysis remains an impediment to data collection thus research priority should be given to the development of less costly analytical methods for the analysis of dioxin and ~~dioxin-like~~ PCBs.

71. Gas chromatography (GC) coupled to Electron Capture Detection (ECD) and mass spectrometers (including ion trap, low-resolution (LRMS), high-resolution (HRMS) and tandem mass (MS/MS) spectrometers) are used in the analysis of NDL-PCBs. The analysis of NDL-PCBs generally does not require as extensive a clean-up procedure as the DL-PCBs or dioxins. For screening purposes, GC-ECD is often used. GC/MS may also be used for screening purposes.

Sampling

72. Important aspects of sampling for dioxin and dioxin-like PCB analysis are collecting representative samples, avoiding cross contamination and deterioration of samples and unambiguously identifying and tracing back samples. **To avoid cross-contamination, samples should be put in containers or other receptacles that are not reactive and that have been chemically cleaned or certified to be free of contaminants** All relevant information on sampling, sample preparation and sample description (e.g., sampling period, geographic origin, fish species, fat content, size of fish) should be recorded in order to provide valuable information.

Analytical methods and data reporting .

73. Analytical methods should be applied only if they are fit for purpose meeting a minimum of requirements. If nationally-established maximum limits are available, the limit of quantification (LOQ) of the method of analysis should be in the range of one fifth of this level of interest. For ~~control of time~~ adequate time trends measurement, ~~of background contamination,~~ the limit of quantification of the method of analysis should be clearly below the mean of the present background ranges for the different matrices.

74. Performance of a method of analysis should be demonstrated in the range of the level of interest, e.g. 0.5 x, 1 x and 2 x level of maximum limit with an acceptable coefficient of variation for repeated analysis. The difference between upper bound and lower bound levels should not exceed 20% for feed and food with a dioxin contamination of about 1 pg WHO-PCDD/PCDF-TEQ/g fat. If needed, another calculation based on fresh weight or dry matter could be considered.

75. Except for bioassay techniques, the results of total dioxin and dioxin-like DL-PCB levels in a given sample should be reported as lower bound, medium bound and upper bound concentration by multiplying each congener by their respective WHO Toxic Equivalency Factor (TEF) and subsequently summing them up to give the total concentration expressed as Toxic Equivalency (TEQ). The three different TEQ values should be generated reflecting assignment of zero (lower bound), half the limit of quantification (medium bound), and limit of quantification (upper bound) values to each non-quantified dioxin and dioxin-like DL-PCB congener. For the analysis of NDL-PCBs the analytical result should also be reported as lower-bound, medium bound and upper-bound and indicate clearly to what the analytical result refers to (sum of six indicator PCBs, total PCBs, etc.)

76. Depending on sample type, the reported information ~~of the analytical results~~ may also include the lipid or dry matter content of the sample as well as the method used for lipid extraction and for determination of dry matter. This report should also include a specific description of the procedure used to determine the level of quantification (LOQ).

77. A high throughput screening method of analysis with proven acceptable validation could be used to screen the samples with significant levels of dioxins and ~~dioxin-like~~ PCBs. Screening methods should have less than 1% false-negative results in the relevant range of interest for a particular matrix. Use of 13C-labelled internal standards for dioxins or dioxin-like PCBs allows for specific control of possible losses of the analytes in each sample. ~~In this way~~As such, false-negative results can be avoided thus preventing contaminated food or feed being used or marketed. For confirmatory methods, use of these internal standards is mandatory. For screening methods without control of losses during the analytical procedure, information on correction of losses of compounds and the possible variability of results should be given. Levels of dioxins and dioxin-like PCBs in positive samples (above the level of interest) should be determined by a confirmatory method.

Laboratories :

~~Performance of a method of analysis should be demonstrated in the range of the level of interest, e.g. 0.5 x, 1 x and 2 x level of maximum limit with an acceptable coefficient of variation for repeated analysis. The difference between upper bound and lower bound levels should not exceed 20% for feed and food with a dioxin contamination of about 1 pg WHO-PCDD/PCDF-TEQ/g fat. If needed, another calculation based on fresh weight or dry matter could be considered.~~

~~Except for bioassay techniques, the results of total dioxin and dioxin-like PCB levels in a given sample should be reported as lower bound, medium bound and upper bound concentration by multiplying each congener by their respective WHO Toxic Equivalency Factor (TEF) and subsequently summing them up to give the total concentration expressed as Toxic Equivalency (TEQ). The three different TEQ values should be generated reflecting assignment of zero (lower bound), half the limit of quantification (medium bound), and limit of quantification (upper bound) values to each non-quantified dioxin and dioxin-like PCB congener.~~

~~Depending on sample type, the report of the analytical results may include the lipid or dry matter content of the sample as well as the method used for lipid extraction and for determination of dry matter. This report should also include a specific description of the procedure used to determine the level of quantification (LOQ).~~

~~A high throughput screening method of analysis with proven acceptable validation could be used to screen the samples with significant levels of dioxins and dioxin-like PCBs. Screening methods should have less than 1% false-negative results in the relevant range of interest for a particular matrix. Use of 13C-labelled internal standards for dioxins or dioxin-like PCBs allows for specific control of possible losses of the analytes in each sample. In this way, false-negative results can be avoided preventing contaminated food or feed being used or marketed. For confirmatory methods, use of these internal standards is mandatory. For screening methods without control of losses during the analytical procedure, information on correction of losses of compounds and the possible variability of results should be given. Levels of dioxins and dioxin-like PCBs in positive samples (above the level of interest) should be determined by a confirmatory method.~~

~~In housings without a floor covering, the animals normally will take up soil particles from the ground. If there are indications of increased levels of dioxins and dioxin-like PCBs, the contamination of the soil should be controlled as necessary. If needed, the soil should be exchanged.~~

~~**78.** Pentachlorophenol-treated wood in animal facilities has been associated with elevated levels of dioxins in beef. Wood (e.g., railroad ties, utility poles) treated with chemicals such as pentachlorophenol or other unsuitable materials should not be used as fence posts for enclosures of free-range animals or feed lines. Hay racks should not be constructed from such treated wood. In addition, the preservation of wood with waste oils should also be avoided.~~

79. Laboratories involved in the analysis of dioxins and ~~dioxin-like~~ PCBs using screening as well as confirmatory methods of analysis should be accredited by a recognized body operating in accordance with ISO/IEC Guide 58:1993 as revised by ISO/IEC 17011:2004 or have quality assurance programmes that address all

critical elements of accrediting agencies to ensure that they are applying analytical quality assurance. Accredited laboratories should follow the ISO/IEC/17025 "General requirements for the competence of testing and calibration laboratories" or other equivalent standards.

~~80.~~ ~~The~~ Regular participation in interlaboratory studies or proficiency tests for the determination of dioxins and ~~dioxin-like~~ PCBs in the relevant feed and food matrices is highly recommended according to ISO/IEC/17025 Standard. QUALITY MANAGEMENT AND EDUCATION-

81. Good Agricultural Practices, Good Manufacturing Practices, Good Storage Practices, and Good Animal Feeding Practices ~~and Good Laboratory Practices~~ are valuable systems for further reduction of dioxin and ~~dioxin-like~~ PCB contamination in the food chain. Farmers as well as ~~and~~ feed and food manufacturers should consider ~~educating their co-workers~~ informing their employees on how to prevent contamination by the implementation of control measures. Good Laboratory Practices is valuable systems to ensure high quality of the analytical outcome.

~~82.~~ ~~**Monitoring**~~

- ~~Farmers and industrial feed and food manufacturers have the primary responsibility for feed and food safety. Testing could be conducted within the framework of a food safety programme (e.g. Good Manufacturing Practices, On-Farm Safety programmes, Hazard Analysis and Critical Control Point programmes, etc.) In previous sections of this Code, it is mentioned where it could be appropriate to perform monitoring. Competent authorities should enforce the primary responsibility of farmers, feed and food manufacturers for feed and food safety through the operation of surveillance and control systems at appropriate points throughout the food chain, from the primary production to the retail level. In addition competent authorities should set up own monitoring programmes.~~

- ~~As analyses for dioxins are quite expensive in comparison to determination of other chemical contaminants, periodic tests should be performed to the extent feasible at least by industrial feed and food manufacturers including both incoming raw materials and final products and data should be kept.~~

- ~~The frequency of sampling should consider results from previous analysis (by individual companies and/or via a pool of industry results within the same sector). If there are indications of elevated levels of dioxins and dioxin-like PCBs, farmers and other primary producers should be informed about the contamination and the source should be identified.~~

- ~~Monitoring programmes dealing with contaminations originating from the environment, accidents or illegal disposals should be organized by operators in the feed and food chain to the extent feasible and competent national authorities in order to obtain additional information on food and feed contamination. Products or ingredients at risk or found with elevated contamination should be monitored more intensively. For example, monitoring programmes may include major fish species used in food or feed that have been shown to contain elevated levels of dioxins and dioxin-like PCBs.~~

~~**83. Sampling, analytical methods, data reporting and laboratories**~~

- ~~Advice concerning analytical requirements and qualification of laboratories is given in the literature. These recommendations and conclusions form the basis of the evaluation by JECFA and others. Furthermore, consideration of methods of analysis of dioxins and dioxin-like PCBs is addressed by the Codex Committee of Methods of Analysis and Sampling.~~
- ~~Traditional methods for the analysis of dioxin and dioxin-like PCBs rely on high-resolution mass spectrometry which is time-consuming and expensive. Alternatively, bioassay techniques have been developed as high throughput screening methods which can be less expensive than traditional methods. However, the cost of analysis remains an impediment to data collection thus research priority should be given to the development of less costly analytical methods for the analysis of dioxin and dioxin-like PCBs.~~

~~**a. Sampling**~~

- ~~Important aspects of sampling for dioxin and dioxin-like PCB analysis are collecting representative samples, avoiding cross-contamination and deterioration of samples and unambiguously identifying and tracing back samples. All relevant information on sampling, sample preparation and sample description (e.g., sampling period, geographic origin, fish species, fat content, size of fish) should be recorded in order to provide valuable information.~~

~~b. Analytical methods and data reporting .~~

- ~~Analytical methods should be applied only if they are fit for purpose meeting a minimum of requirements. If nationally-established maximum limits are available, the limit of quantification (LOQ) of the method of analysis should be in the range of one fifth of this level of interest.~~
- ~~For control of time trends of background contamination, the limit of quantification of the method of analysis should be clearly below the mean of the present background ranges for the different matrices.~~

ANNEX

GLOSSARY OF TERMS (for the purpose of this code of practice)

Term	Explanation
anticaking agent	~~substance that increase the tendency of individual particles of a feed or food to adhere~~ Substance that reduces the tendency of particles of a feed or food to stick

binder	substance that increase the tendency of individual particles of a feed or food to ~~adhere~~ stick
coefficient of variation	statistical parameter expressing: 100 x standard deviation of a set of values/mean value of set
~~binder~~	~~substance that increase the tendency of individual particles of a feed or food to adhere~~
confirmatory method of analysis	method of analysis with high quality parameters capable to confirm analytical results produced from screening methods with lower quality parameters
congener	one of two or more compounds of similar chemical structures ~~the same kind~~ with respect to classification
dioxins (PCDD/PCDF)	Includes 7 polychlorinated dibenzo-p-dioxins (PCDDs) and 10 dibenzofurans (PCDFs) with similar toxicological prosperities and belong to a group of lipophilic and persistent organic substances. Depending on the degree of chlorination (1–8 chlorine atoms) and the substitution patterns, 75 different PCDDs and 135 different PCDFs ("congeners"), can be distinguished
dioxin-like (DL-PCBs)	Includes 12 non-ortho and mono-ortho substituted polychlorinated biphenyls (PCBs) showing toxicological properties (dioxin-like activity) that are similar to dioxins ~~(25)~~
fish	~~cold-blooded~~ Poikilothermic vertebrate animals including Pisces, Elasmobranches and Cyclostomes. For ~~the purpose of~~ this code of practice, molluscs and crustaceans are also included ~~(41).~~
feed	any single or multiple materials, whether processed, semi-processed or raw which is intended to be fed directly to food producing animals (27)

food	any substance, whether processed, semi-processed or raw which is intended for direct human consumption, and includes drink, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but does not

	include cosmetics, tobacco, medicinal products, narcotic or psychotropic substances, residue and contaminant ~~used only as drugs.~~
feed or food ingredient	a component or constituent of any combination or mixture making up a feed or food, whether or not it has a nutritional value in the diet, including additives. Ingredients are of plant, animal or aquatic origin, or other organic or inorganic substances.
guideline levels	~~not statutory but recommended maximum levels~~ The maximum concentration of a substance which is recommended by a national or international authority to be acceptable in feed or food, however not legally binding
HACCP	Hazard Analysis Critical Control Point (HACCP) is a system that identifies, evaluates and controls hazards which are significant for food safety
limit of quantification (LOQ) (valid for dioxins and dioxin-like PCBs only)	the limit of quantification of an individual congener means the lowest ~~is the~~ concentration of ~~an~~ the analyte that can be measured with reasonable statistical certainty, fulfilling the identification criteria as described in internationally recognized standards such as in EN 16215:2012 and/or EPA method 1613 and 1668 as revised. The limit of quantification of an individual congener may be identified as the concentration of analyte in the extract of a sample which produces an instrumental response at two different ions to be monitored with an S/N (signal/noise) ratio of 3:1 for the less sensitive signal and fulfilment of the basic requirements such as e.g. retention time, isotope ratio according to the determination procedure as described in EPA method 1613 as revised ~~revision B (38, 54).~~
maximum limits	~~statutory maximum limits for contaminants~~ Legally binding maximum concentration of a substance in feed or food, established by a national or international authority
minerals non dioxin-like PCBs (NDL-PCBs)	Inorganic compounds used in food and feed required for normal nutrition or used as processing aids Includes the 197 PCB congeners other than the 12 non-ortho and mono-ortho substituted PCBs. The NDL-PCBs account for the majority of the total PCB contamination, the remainder being DL-PCBs. The Stockholm Convention on POPs recommends the measurement of six indicator PCBs (PCB 28, PCB52, PCB

	101, PCB, 138, PCB 153 and PCB 180) to characterise contamination by NDL-PCBs.
PCBs	polychlorinated biphenyls belonging to a group of chlorinated hydrocarbons, ~~which are~~ formed by direct chlorination of biphenyl. Depending on the number of chlorine atoms (1 – 10) and their position at the two rings, 209 different compounds ("congeners") are theoretically possible ~~(25).~~ The 209 congeners of PCBs include the dioxin-like PCBs (12 congeners) and the non-dioxin-like PCBs (197 congeners)

PCP pelagic fish species	Pentachlorophenol fish species living in free water (e.g., ocean, lake) without contact to the sediment
persistent organic pollutant (POP)	chemical substance that persists in the environment, bioaccumulates through the food web, and poses a risk of causing adverse effects to human health and the environment
Stockholm Convention (POPs Convention)	The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from persistent organic pollutants (POPs) including dioxins and dioxin-like PCBs and entered into force on 17th May 2004. In implementing the Stockholm Convention governments will take measures to eliminate or reduce the release of POPs into the environment.
screening method of analysis	method of analysis with lower quality parameters to select samples with significant levels of an analyte
trace elements	chemical elements essential for plant, animal and/or human nutrition in small amounts
Toxic Equivalency Factor (TEF)	Estimates of the toxicity of dioxin-like compounds relative to the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which is assigned a TEF of 1.0

	WHO-TEFs for human risk assessment are based on the conclusions of the World Health Organization (WHO) – International Programme on Chemical Safety (IPCS) expert meeting (Geneva, June 2005)
Toxic Equivalency (TEQ)	relative value calculated by multiplying the concentration of a congener by the toxic equivalency factor (TEF)
WHO- -TEQ	TEQ value for dioxins and dioxin-like PCBs, established by WHO and based on established Toxic Equivalency Factors (TEFs) (37)
~~Toxic Equivalency Factor (TEF)~~	~~Estimates of the toxicity of dioxin-like compounds relative to the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which is assigned a TEF of 1.0~~

REFERANCES

- CAC/RCP No. 62/2006
- Egypt standard**2010/7236**