

CODEX ALIMENTARIUS COMMISSION



Food and Agriculture
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World Health
Organization

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Agenda Item 8

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JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON CONTAMINANTS IN FOODS

Tenth Session

Rotterdam, The Netherlands, 4 – 8 April 2016

PROPOSED DRAFT MAXIMUM LEVELS FOR CADMIUM IN COCOA AND COCOA-DERIVED PRODUCTS

Comments at Step 3 submitted by Australia, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, Ghana, India, Indonesia, Kenya, Republic of Korea, African Union (AU), ECA, Food, Drink Europe, ICA and ICGMA

AUSTRALIA

Australia would like to thank the Codex Committee on Contaminants in Foods (CCCF) electronic working group (eWG) for preparing *Proposed Draft Maximum Levels for Cadmium in Chocolate and Cocoa-derived Products* (CX/CF 16/10/9), for consideration by the 10th Session of the CCCF (April, 2016).

Australia wishes to make the following observations and comments.

SUMMARY

- Australia supports the work of the eWG towards establishing globally harmonized MLs for Cd in cocoa-derived products, which are protective of public health and safety, and achievable. The establishment of harmonized MLs for these commodities can facilitate trade, particularly in those developing countries that are large exporters of cocoa.
- Australia supports the **first recommendation** to work on categorizing different types of chocolates (e.g. milk chocolate with <30% total dry cocoa solids) and subsequently gathering occurrence data on samples of chocolate based on their different categories.
- Australia suggests that all work on establishing MLs for various food categories be suspended until this additional work is undertaken, as it will help inform the selection of appropriate food categories and establishment of MLs based on actual data. Furthermore it will enable the levels set in the final products to be consistent with any levels set for raw materials.
- The rationale for the **second recommendation** to request CCMAS to standardize the evaluation methods for the determination of Cd in cocoa and its sub-products is needed. The request to CCMAS should also be clarified i.e. is CCCF requesting the development of a set of criteria for analytical methods?
- Australia does not support the **third recommendation** regarding proposed MLs for cocoa liquor and powder (3.0 mg/kg and 4.0 mg/kg respectively), as there is still insufficient rationale for these food categories and their respective MLs, as detailed further below.
- JECFA has concluded that dietary exposures to Cd from products containing cocoa and its derivatives are not a public health and safety concern. Therefore, Australia is of the view that MLs should be derived primarily on the basis of achievability. MLs should be sufficiently flexible to support small farming communities in developing countries, industry innovation, and global trade.

DETAILED OBSERVATIONS AND COMMENTS

Proposed food categories and MLs

- Australia notes that there were wide-ranging views amongst eWG members regarding the application of MLs to raw, intermediate or finished products.
- The approach in the final report of the EWG focuses on proposed MLs for sub-products cocoa liquor and cocoa powder. This is a departure from previous versions of the paper, which included both intermediary commodities and finished products.
- The proposed MLs for cocoa liquor and powder accommodate the vast majority of the Latin American origin product (which generally has higher levels of Cd and also accommodate the vast majority of Australian products, both domestically produced and imported).
- However, Australia does not support the **third recommendation** regarding the proposed food categories and their respective MLs, as we are of the view that there is insufficient rationale underpinning these. In particular:
 - MLs are proposed for these particular sub-products rather than the commodities, cocoa beans and nibs, because cocoa beans and nibs require further processing and are not consumed directly. However, it could be argued that cocoa liquor is also not consumed directly, and is subject to further processing in the production of chocolates and other cocoa-derived products
 - There is a lack of information regarding how the Cd levels in the selected sub-products will translate to levels in finished products intended for direct human consumption
 - In the case of data on cocoa powder from Latin American countries, actual analytical data, rather than data derived using concentration factors, should be used to establish proposed MLs
 - The selected sub-products are not the mostly highly traded products globally.
- The conclusions state that these sub-products were selected in preference to finished products, due to a lack of available data and clear categories for different chocolates. In this regard, Australia supports the **first recommendation** to work on categorizing different types of chocolates (e.g. milk chocolate with <30% total dry cocoa solids) and subsequently gathering occurrence data in samples of chocolate based on their different categories, to enhance the existing evidence base¹.
- In addition, there is merit in giving further consideration to establishing MLs for finished products because:
 - Australian import data indicates that finished products (chocolates) are traded in much greater volumes than cocoa liquor and powder. An earlier version of the paper likewise noted that products containing cocoa represent the largest proportion (nearly two-fifths) of imports worldwide in terms of value, followed by cocoa beans (22%), cocoa butter (12%), cocoa mass (5%) and cocoa powder (4%)
 - Cd levels in sub-products such as cocoa liquor and powder may have no direct relevance to Cd levels in the finished product. This is because variations in cocoa content and the industry practice of blending can have a significant reducing effect on the Cd content of the finished products.

Results of dietary exposure assessment and achievability

- The conclusions state that an exposure assessment conducted using GEMS/Food data (submitted by various countries) and CAOBISCO data demonstrates that dietary exposure is well below the Provisional Tolerable Monthly Intake (PTMI) of 25 µ/kg bw, set by JECFA in 2010, for both cocoa liquor and powder.
- Australia notes that the JECFA assessment concluded that dietary exposures to Cd from products containing cocoa and its derivatives are not a public health and safety concern (JECFA, 2013).
- Therefore, Australia is of the view that MLs established for chocolate and cocoa-derived products should be based solely on practical achievability worldwide rather than on public health and safety considerations.

¹ An earlier version of the eWG paper indicates that GEMS/Food data for cocoa products such as beverage powders and chocolates are currently limited.

CHILE

Chile appreciates the work done by Ecuador, Brazil and Ghana, and agrees with the proposed maximum levels for Cadmium in cocoa liquor and cocoa powder, with the understanding that the intake of cadmium by chocolate consumption and cocoa-derived products would not be cause for concern, according to indicated by JECFA in the CX/CF 16/10/9 document. Chile disagrees with the recommendation to work in the categorization of the different types of chocolates, without setting before a maximum level for the matrices indicated in this document (cocoa liquor and cocoa powder)

COLOMBIA

Colombia is presenting its position on the proposed draft maximum levels for cadmium in cocoa and derived products, in the sense that we don't support its advancement in the Codex Alimentarius steps.

This is so because the document proposed by the EWG led by Ecuador and co-chaired by Brazil and Ghana is not presenting a clear and appropriate categorization of the different types of chocolates for human consumption, and the proposed maximum levels only for cocoa liquor and cocoa powder as raw matter did not use the data submitted by different countries in the region that are cocoa and byproducts producers.

Thus, we ask to slow down this item in the CCCF, while the EWG is reactivated and making clear its mandate that could be to develop a categorization and definition of the data to be used to set the levels for the contaminant.

As a result, we recommend that the data be used to propose different ML for cadmium in foods to be defined and which are produced from cocoa, reflecting the situation of Latin America regarding the content of that metal.

COSTA RICA

Costa Rica would like to congratulate Ecuador and Brazil for the progress in the content of the document; it also appreciates the opportunity given for providing the following comments:

1. Paragraph 10, second bullet.

It is recommended to replace the term "~~cocoa bean~~" by "processed grain", as set out in graph No. 1. Or change what is set out in this graph. In the English version.

Justification: harmonize the used terminology throughout the document.

2. Review and correct operations and calculations of the units included in Appendix I, Annex I and II, page 13, English version.

Bodyweight: 60kg.

Also correct the following operation: $60 * 0.025 = 1.5$ not 1.75 mg.

Note: It is interpreted as if the calculations had been made on the basis of 70 kg.

3. Intake of Cd (ug/kg bw monthly) = $0.00375 \text{ mg/kg} * 0.51 \text{ mg/kg} = 0.0019125 \text{ mg/kg}$

Note: It is unclear, since the multiplication of the units cannot be mg/kg.

Justification: In the first factor in kg it is weight, and the second factor in kg it is liquor.

DOMINICAN REPUBLIC

The Dominican Republic is a cocoa producing and exporting country which recognizes the economic importance that has the marketing of cocoa and its derivatives globally, considers important that maximum levels (ML) be established for cadmium (Cd) in cocoa and its derivatives, which ensure the safety of processed products and allow equity in trade, where consumers anywhere in the world have full confidence that by consuming cocoa and its derivatives the level present of that contaminant will not be of significance.

The Dominican Republic supports the proposed recommendations of MLs for cadmium by the eWG:

- Proposed ML for Cd in chocolate and cocoa and its derivatives

PRODUCT	ML of Cd (mg/kg)
Cocoa liquor	3.0
Cocoa powder	4.0

We also support that working document CX/CF 16/10/9 be approved at Step 3 and also the other recommendations identified by the eWG:

- The CCCF continues working on the categorization for different types of chocolates and subsequently recommends gathering of scientific data on the occurrence of Cd in samples of chocolate based on the different categories.
- The EWG requests the CCMAS to standardize the evaluation methods for the determination of Cd in cocoa and its sub-products

ECUADOR

(i) General Comments:

Ecuador thanks the Chair of this Electronic Working Group (EWG) and Brazil and Ghana as co-chairs; in this regard it wishes to express the following:

In order to move forward with this proposed standard, Ecuador supports the proposed levels by the EWG, and the conclusions and recommendations thereof, because the document meets two of the main objectives of the Codex Alimentarius, which are highlighted in the protection of consumer health and in maintaining fair practices in food trade.

Additionally, Ecuador suggests that the term “cocoa powder” be strengthened, insofar as it could be confused with similar terms that are cited in other regulations or international regulations.

(ii) Specific comments:

- Proposed draft maximum levels for cadmium in ~~cocoa~~ **chocolate** and cocoa-derived products

Rationale: This proposed draft maximum levels is focused in chocolate and cocoa products, as in the 8th meeting of the CCCF (2014), the terms of reference were as follows: “*The Committee agreed to start new work on MLs for cadmium in chocolate and cocoa products for approval by the 37th session of the Commission*”; in the same way in the 9th meeting of the CCCF (2015), the Committee agreed to re-establish this eWG under the same name, i.e. “Proposed draft maximum levels for cadmium in chocolate and cocoa products”.

- (Prepared by the Electronic Working Group chaired by Ecuador and co-chaired by Brazil **and Ghana**).

Rationale: According to the 8th session of the CCCF, “the Committee agreed to establish an electronic working group led by Ecuador, co-chaired by Ghana and Brazil, that would work in English and Spanish, to develop proposals for MLs...”; and later, in the 9th session of the CCCF, the Committee re-established this eWG chaired by Ecuador, and co-Chaired by Brazil and Ghana; therefore this country (Ghana) should be included in the aforementioned title.

- It is requested to review the units, since in Table 10, corresponding to the “Summary of the impact of different MLs for Cd in the statistical distribution of Cd in the liquor and cocoa powder Latin American countries and other sources, including the proportion expected PTMI Cd intake for the diet group 7 and the proportion of rejected samples provided in the global market” in the fourth column “Cd intake (**g/lg** monthly p.c.)” are units that do not exist, therefore it is requested clarification on them.
- In Appendix I, corresponding to Annexes I (Exercise of estimated monthly consumption of Cd in samples of cocoa liquor) and II (Exercise of estimated monthly consumption of Cd in samples of cocoa powder) it is requested to provide a clarification of the calculations, since in the item corresponding to “monthly intake”, the corresponding fact to 1.75 is a fact which is not known where it is obtained from.

EGYPT

I would like to thank the Electronic Working Group and inform you that Egypt approved the following recommendations:

1. Work on the categorization for different types of chocolates and subsequently recommends gathering of scientific data and the occurrence of Cd in samples of chocolate based on the different categories.
2. Request CCMAS to standardize the evaluation methods for the determination of Cd in cocoa and its sub-products.

For the recommendations of the special maximum level of Cd

Egypt supports the low levels to protect the health and consumers especially the children, so we suggest to proceed a re-study on the proposed limits due to the height.

EL SALVADOR

El Salvador welcomed the document prepared by Ecuador and Brazil.

Preliminarily we support the ML proposed for cocoa liquor, (3.0 mg/kg) and cocoa powder (4.0 mg/kg). However, we think that the ML for Cd should be established for ready to use products, with the aim of protecting the health of consumers and ensuring fair trade practices.

We support the continuation of the Working Group with the purpose of working in the categorization of the different types of chocolates and the collection of scientific data on the occurrence of Cd in samples of chocolates, on the basis of the different categories, and asking the support of Codex Alimentarius through the CCMAS to standardize the assessment methods for the determination of Cd in cocoa and its by-products.

GHANA

Ghana wishes to commend the eWG on development of maximum levels for cadmium in cocoa and cocoa-derived products, for the very useful and forward-looking comments and suggestions submitted during the work of the eWG. Ghana has always supported the Codex cardinal principles of consensus building and inclusiveness and believes that these principles are vital to developing Codex standards with global acceptability.

Despite the efforts of the eWG, we do not believe that the eWG reached consensus on

1. the categories of products for which MLs for cadmium should be developed and
2. the proposed ML for cocoa powder (4mg/kg) and cocoa liquor (3mg/kg).

In this regard we recommend that more extensive and opened discussion is needed to clearly articulate the rationale for product categories before the development of MLs can be considered. Moreover, establishment of MLs for cadmium in cocoa and cocoa-derived products should be premised on global occurrence data. This will ensure that the established MLs adequately account for regional differences in terms of production and consumption. Such an approach could facilitate consensus and ensure the timely adoption of the MLs.

INDIA

India appreciates the work initiated by the EWG. However, India does not support the proposed MLs for cocoa liquor and cocoa powder.

Rationale:

These MLs appear to be proposed on the basis of the highest level of cadmium observed in the samples and a least possible exclusion of the commodity from international trade. A lower ML (i.e. 2.0 mg/kg for cocoa liquor and 2.0 mg/kg for cocoa powder) could be acceptable even if up to 5% of the commodity samples run a risk of getting excluded from international trade as has been the approach in revising the MLs for contaminants in several other commodities so far.

INDONESIA

The followings are Indonesia comments:

Products	ML of Cd (mg/kg)	Indonesia comments
Cocoa liquor	3.0	The proposed MLs of 3 mg/kg could lead high concentration of Cd in final product since cocoa liquor mainly uses for chocolate with high cocoa content, therefore showing their uniqueness (cocoa origin uniqueness). Therefore, Indonesia would like to propose the MLs of 2 mg/kg .
Cocoa powder	4.0	The proposed MLs of 4 mg/kg could lead high concentration of Cd in final product, Indonesia proposes MLs of 1 mg/kg for Cd in cocoa powder, since the uses of cocoa powder in product formulation up to 90% not exceed the PTWI of Cd.

KENYA**SPECIFIC COMMENT**

We agreed with the first recommendation of EWG which states that:

“The EWG recommends to work on the categorization for different types of chocolates and subsequently recommends gathering of scientific data on the occurrence of Cd in samples of chocolate based on the different categories.” **and West Africa countries which produce 72% and Latin America to avail data to GEMS/Food for setting/re-evaluating the safe limit**

We also accept bullet two which states as follows:

“The EWG recommended to request CCMAS to standardize the evaluation methods for the determination of Cd in cocoa and its sub-products”.

REPUBLIC OF KOREA

The Republic of Korea suggests the EWG to propose the maximum level of cadmium in cocoa liquor and cocoa powder based on the combined data of GEMS/Food and CAOBISCO rather than analyzing them separately.

AFRICAN UNION (AU)

Position 1: AU agrees to the setting of MLs for cadmium in cocoa and cocoa –derived products

Issue and Rationale: Contamination of cadmium in food has become a concern in many countries. The metal can accumulate in kidneys leading to irreversible renal tubular dysfunction. High cadmium intake is also associated with the formation of kidney stones as well as problems with the skeletal and respiratory systems. Cadmium is abundant in nature and can be released to the environment in different ways including natural activities such as volcanic activities and through anthropogenic activities such mining and smelting of ores containing zinc, burning of fossil fuels and emissions from discarded batteries.

About 72% of the world supply of cocoa beans comes from West Africa, especially Cote d'Ivoire, Ghana and Nigeria. Cadmium levels in cocoa beans can vary considerably between regions. The region of lowest concentration is West Africa. For instance, the highest cadmium levels in cocoa shells of Ghana was reported to be 0.75mg/kg. Studies by Takrama et al. (2015) in Ghana also showed that cadmium levels in cocoa nibs ranged from 0.248 to 0.336 mg/kg with a mean value of 0.269 mg/kg (n=67).

Position 2: AU has no objection to the proposed MLs of 3.0mg/kg for Cocoa liquor and 4.0mg/kg for Cocoa powder,

Rationale: The highest per capita cocoa and its derivatives consumption ranges from 0.1 – 7.5 g/day through the GEMS/Food 17 groups of diet. Most African countries are in the lowest part of the consumption range. Group/Cluster 7 (consisting of Australia, Bermuda, Finland, France, Iceland, Luxembourg, Norway, Switzerland, United Kingdom and Uruguay) has the highest per capita consumption. Using the highest consumption data of 7.5g/day as the worst case scenario, the intake calculated with the proposed ML of 3mg/kg for cocoa liquor is 7.69% of the recommended JECFA PTMI of 25 µg/kg bw. For cocoa powder using the proposed ML of 4mg/kg, the calculated intake is 4.15% of the JECFA PTMI.

EUROPEAN COCOA ASSOCIATION (ECA)

- According to the information obtained from the GEMS/Food and CAOBISCO, the EWG would like to suggest the following ML for Cd in cocoa liquor and cocoa powder:

REMARKS:

The proposed levels for cocoa liquor and cocoa powder are set at a level which may appear to be manageable as such.

However, we would like to bring the following aspects into consideration:

- It is of paramount importance that limits do not negatively impact international trade.
- Any possible limits should be established on the basis of JECFA's Committee opinion.
- We push for limits which are workable for the whole industry, including the one working with fine flavor cocoa products.
- It may be worth considering to set maximum limits on a dry fat free cocoa solids basis rather than on total cocoa solids as this system seems to be more relevant.

- To meet the objective of ensuring consistency and no negative impact on trade, it would be important that the existing EU limits for maximum levels of cadmium are revised - as foreseen under Commission Recommendation 2014/193/EU – Recital (9).
- Within the supply chain, suppliers could argue that their products comply with the suggested Codex levels should they receive requests for lower levels from manufacturers - aimed at ensuring compliance with existing limits on finished products established in certain regions and/or countries.
- In a possible scenario, companies will probably set their own specifications when buying cocoa beans to meet regional and/or national requirements/limits on finished products.
- These suggested Codex maximum levels should not lead to a non-harmonized trade environment.

Table Proposal ML of Cd in chocolate and cocoa and cocoa derived products.

PRODUCT	ML of Cd (mg/kg)
Cocoa liquor	3.0
Cocoa powder	4.0

□ **10. DEFINITIONS**

- **Percentage of cocoa solids:** It refers to the total percentage of **ingredients** by weight in the product that comes from the cocoa bean, including liquor and cocoa butter.

REMARK: To be replaced by the Codex definition, i.e “percentage on chocolate part of products after deduction of other permitted edible foodstuff”

- **Non-fat cocoa solids:** Are all cocoa components (carbohydrates, fiber, protein and minerals), which were subtracted the fat and **moisture**.

REMARK: Suggestion to delete “moisture” and to replace it by “dry non-fat cocoa solids”

CADMIUM OCCURRENCE IN COCOA BY PRODUCTS SAMPLES

29. As described above, the cocoa beans and nibs represent 27.4% of world trade, however, these products are not directly consumed because they must first undergo to an industrial processing transformation to obtain **byproducts as liquor, powder and cocoa butter**, raw material for the production of chocolates and cocoa derived products.

REMARK: Cocoa liquor not considered as a byproduct.

32. Considering a process under standardized conditions, it is known that from 1.0 kg of cocoa liquor,

0.6 kg of cocoa powder and 0.4 kg of cocoa butter are obtained. Taking into account that the entire content of Cd remains in the fat-free cocoa solids, cocoa powder would have a concentration factor of 1.67; since then **the** data for cocoa powder Latin America were calculated.

REMARK: To add “the cadmium content in cocoa powder from cocoa liquor data in Latin America”

36. Lee & Low (1985) evaluated intermediate products in the stages of chocolate manufacturing (roasted cocoa, liqueur, paste, cake, nibs and shell). They noted that there is contamination in the involved processes **and** they also noted that the addition of ingredients such as milk and sugar does not contribute effectively into metal increasing concentrations.

REMARK: The Lee a& Low article “Determination of cadmium, lead, cooper and arsenic in raw cocoa, semi finished and finished chocolate products” (1985) clearly demonstrated that “*there were no effective contaminations of metals during the manufacturing process; the amount of metals in the finished products corresponded to the fraction of cocoa mass present*”.

Table 10. Summary of the impact of different ML for Cd in the statistical distribution of Cd in the liquor and cocoa powder Latin American countries and other sources, including the proportion expected PTMI Cd intake for the diet group 7 and the proportion of rejected samples provided in the global market.

REMARK: To be replaced by “per kg BW”

Scenario	No. samples	Average Content of Cd (mg/kg)	Cd intake (g/lg monthly p.c.)	PTMI (%)	Possible rejected samples (%)
COCOA LIQUOR					
Without ML	285	0.57	2.14	8.55	0 - 100
ML: 3.0 mg/kg	281	0.51	2.92	7.69	1.40
ML: 2.0 mg/kg	272	0.45	2.69	6.78	4.56
ML: 1.0 mg/kg	239	0.33	1.23	4.92	16.14
ML: 0.5 mg/kg	187	0.21	0.77	3.09	34.39
ML: 0.3 mg/kg	133	0.13	0.50	1.98	53.33
COCOA POWDER					
Without ML	1310	0.30	1.130	4.52	0 - 100
ML: 4.0 mg/kg	1304	0.28	1.037	4.15	0.46
ML: 3.0 mg/kg	1296	0.26	0.961	3.84	1.07

FOODDRINKEUROPE

The proposed levels for cocoa liquor and cocoa powder are set at a level which may appear to be manageable as such. However, we would like to bring the following aspects into consideration:

- It is of paramount importance that limits do not negatively impact international trade.
- Any potential Codex maximum level should be established on the basis of JECFA's Committee opinion.
- We support maximum levels which are workable for the whole industry, including the one working with fine flavour cocoa products.
- It may be worth considering to set maximum limits on a dry fat free cocoa solids basis rather than on total cocoa solids as this system seems to be more relevant.
- Within the supply chain, suppliers could argue that their products comply with the suggested Codex levels should they receive requests for lower levels from manufacturers - aimed at ensuring compliance with existing limits on finished products established in certain regions and/or countries.
- In a possible scenario, companies will probably set their own specifications when buying cocoa beans to meet regional and/or national requirements/limits on finished products.
- These suggested Codex maximum levels should not lead to a non-harmonized trade environment.

INTERNATIONAL COOPERATIVE ALLIANCE (ICA)

We suggest setting maximum limits on a dry fat free cocoa solids basis rather than on total cocoa solids as a system based on non-fat cocoa solids levels would be more workable for the industry.

INTERNATIONAL COUNCIL OF GROCERY MANUFACTURERS ASSOCIATIONS (ICGMA)

The Codex Committee on Contaminants in Food (CCCF) is proposing to set maximum levels on cadmium in cocoa. The levels should reflect what is reasonably achievable; as noted in the December 2014 draft Codex report prepared by Ecuador, "The estimation of JECFA can be demonstrated as follows: if provisional tolerable monthly intake is 25mg/kg bw, i.e. 0.025mg/kg, an adult of average weight (70kg) should consume about 44 chocolate bars of 20g to exceed the provisional tolerable monthly intake of cocoa products." While safety is not in question, the appropriate limit should be based on science that shows what is globally reasonably achievable.

ICGMA welcomes the opportunity to provide feedback on the Proposed Draft Maximum Levels for Cadmium in Cocoa and Cocoa-Derived Products dated February 2016.

1. ICGMA Data on Cadmium in Cocoa and Chocolate Products

In order to assist with determining what levels of cadmium would be achievable in cocoa and chocolate products, ICGMA collected data on 243 samples of various chocolate products and cocoa powders either submitted by member companies or available commercially in the United States. The samples were blinded and tested by a third party laboratory using AOAC method 986.15 mod (ICP-MS). The results show a general trend of increasing levels of Cd as the per cent cacao in products increase (Figure 1) however, the standard deviations are high as shown in Table 1.

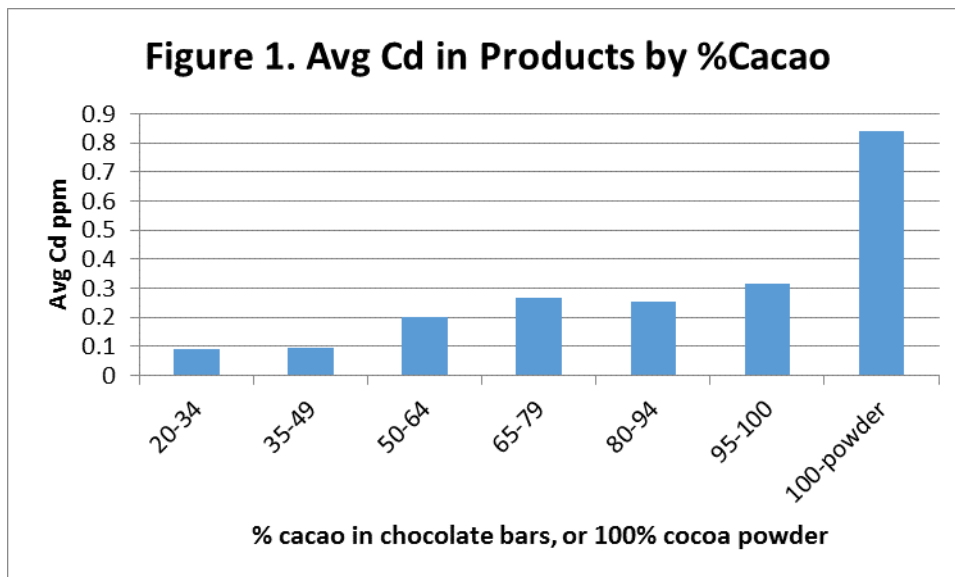
Cocoa powder had the highest levels of cadmium with a range of 0.4 – 2.99 ppm with a 90th percentile of 2.75 ppm and 95th percentile of 2.80 ppm (shown in Figure 2). There are 35 data points, representing 35 different products. For 5 data points, they represent the average of multiple samples of the product (ranging between 2-12 samples).

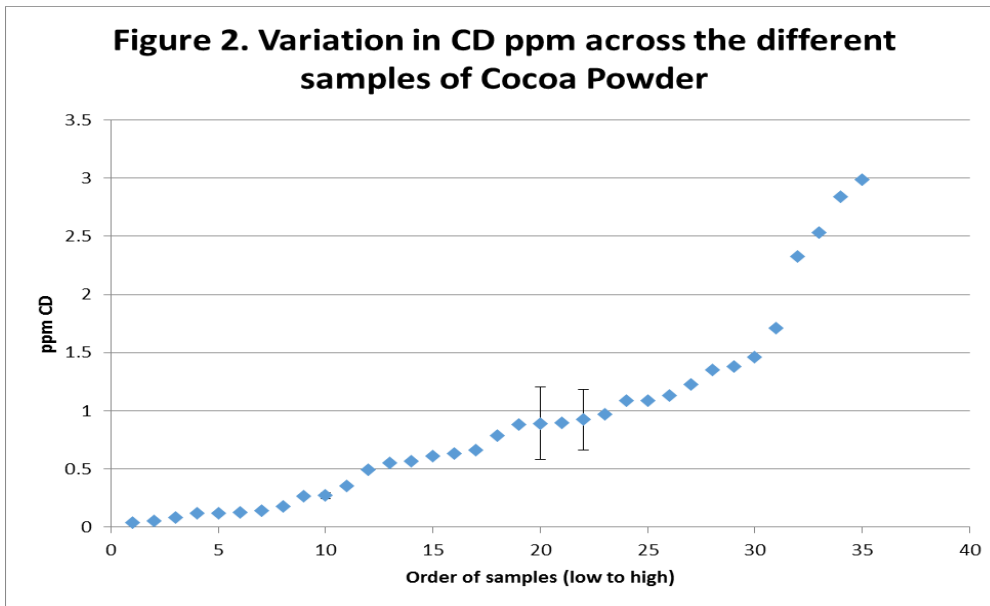
There were 110 unique chocolate samples of chocolate with >50% cocoa solids tested. The samples in this category had a range of 0.01-2.2ppm of cadmium with a 95th percentile of 0.58ppm (shown in Figure 3).

Table 1. Avg Cd in Cocoa and Chocolate Samples

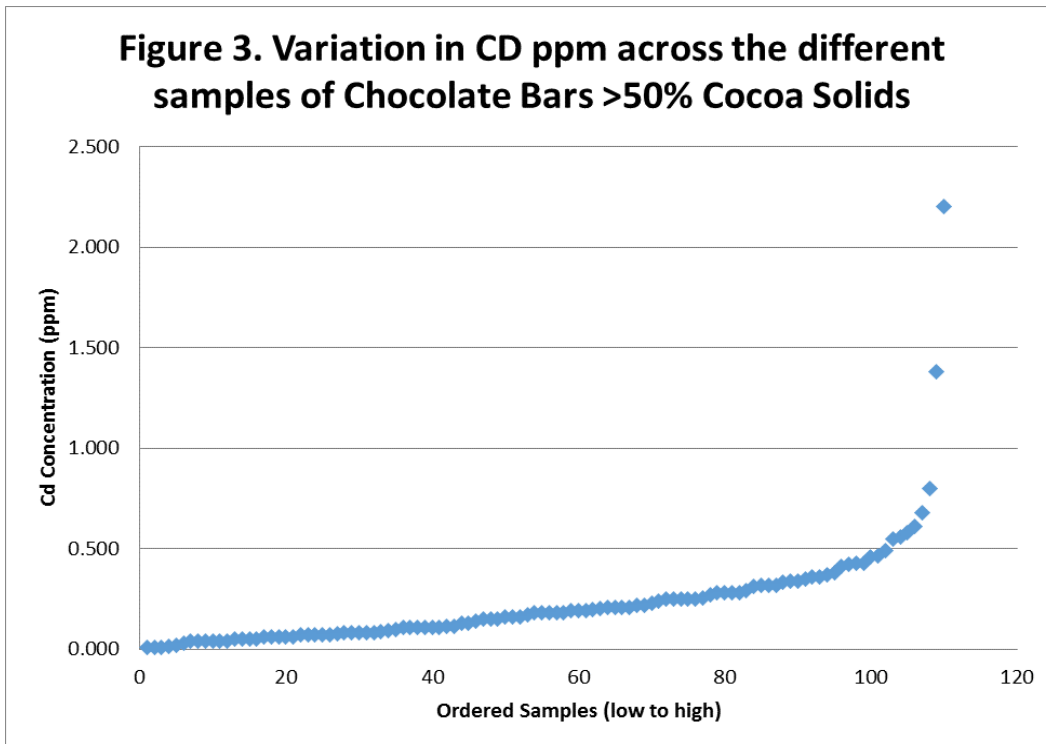
% Cacao	Avg Cd (ppm)	SD
20-34 (n= 20)	0.092	0.054
35-49 (n= 34)	0.095	0.049
50-64 (n= 26)	0.201	0.186
65-79 (n= 46)	0.266	0.365
80-94 (n =8)	0.254	0.154
95-100 (n=39)	0.316	0.163
100-powder (n= 54)	0.842	0.685

Figure 1. Avg Cd in Cocoa and Chocolate Samples





Error bars represent Standard deviation in cases where $n > 1$. Lack of an error bar indicates either no variation or $n = 1$



2. Established Product Categories and Cadmium Limits Should Correspond to Percent Nonfat Cacao Solids

Cocoa solids content ranges substantially in commercially available chocolate and cocoa products. Standards of identity range globally as well in terms of percent cacao content in various finished products. Milk chocolate products produced in some regions may have as little as 2.5% cacao solids, while dark chocolate products with high percent cacao solids products of 90% cacao and higher are gaining popularity in niche markets.

As indicated in paragraph 34 of the Maximum Levels for Cadmium in Cocoa and Cocoa-Derived Products, “it is known that from 1.0 kg of cocoa liquor, 0.6 kg of cocoa powder and 0.4 kg of cocoa butter are obtained. Taking into account that the entire content of Cd remains in the fat-free cocoa solids, cocoa powder would have a concentration factor of 1.67.” This is consistent with CODEX STAN 141-1983, the Standard for Cocoa (Cacao) Mass (Cocoa/Chocolate Liquor) and Cocoa Cake, which indicated that cocoa liquor consist of 47-60% cocoa butter.

Since cadmium corresponds with the nonfat dry cocoa solids portion in chocolate products, from a compliance standpoint, it would be practical to stratify the product categories by percent cacao. One way to accomplish this would be to allow for cadmium content to vary on a sliding scale that would factor in cocoa solids.

This approach could be captured in the General Standard for Contaminants and Toxins in Food and Feed through a reference value and an explanatory note. For example, if a reference value could be provided for 100% cocoa solids with a note clarifying "In order to consider the concentration of the product, the determination of the maximum levels for contaminants shall take into account the natural total nonfat solids." This approach has also been provided for other contaminant levels in foods known to vary substantially by solids content. For example, the standards for lead in preserved tomatoes and processed tomato concentrates use a similarly worded note. Additionally, the standard for lead in milk also acknowledged that a concentration factor applies.

The known ratio of 60% cocoa solids to 40% cocoa butter could be used to calculate maximum levels in products by percent nonfat cacao solids. For example if a 2.0ppm reference value was established for 100% nonfat cacao solids, this would serve as the limit for 100% nonfat cocoa solids. For chocolate product the 60/40 ratio could be used to estimate nonfat cocoa solids content. So, a 100% cocoa liquor product would be expected to not exceed 1.2 ppm and a 50% cacao chocolate product no more than 0.6 ppm.

3. Limits on Finished Products Are Most Protective and Practical

- ***Finished products represent the greatest volume and monetary value of cocoa and chocolate traded commodities***

As per paragraph 15 of the proposed draft maximum limits, finished chocolate and cocoa products contribute the highest percentage of the cocoa and chocolate traded commodities by tonnage. Cocoa beans/nibs were the next highest category, followed by semi finished products (e.g. cocoa liquor). This is also consistent with other industry data, including the 2014 Euromonitor historic market size data shown in table 2 below which shows that chocolate confectionery is substantially greater than cocoa beans in globally traded tonnage.

Table 2: Tonnes Retail Volume Cocoa Commodity

Category	'000 Tonnes
Production of Cocoa Beans	4,673.90
Chocolate Confectionery	7,051.10

- ***Levels of beans and semi-finished products could introduce discriminatory trade barriers***

Established national standards on cadmium in cocoa and chocolate products are based on finished products. In addition to not harmonizing with national standards, establishing limits on raw cocoa beans could prohibit the sourcing from certain regions, which would create discriminatory trade barrier.

- ***Manufacturers have greater control over finished product levels***

Standard processing practices including cleaning, de-shelling, blending and testing beans allow manufacturers to control cadmium content in finished products. Establishing limits on finished products prevents distribution in normal operating procedures for manufacturers.

- ***Limits on finished products are most relevant to consumers***

Although JECFA determined there is no global safety concern from dietary cadmium exposure at this time and limits should be based on what is globally achievable, protecting consumers is the ultimate purpose of contaminant standards. Raw cocoa beans and semi-finished cocoa and chocolate products are not generally commercially available to consumers. These semi-finished ingredients are not consumed in this form, but as processed finished products. Placing limits on finished products assures the greatest level of protection for consumers.