

Author's response to reviews

Title: Consumer exposure to biocides - identification of relevant sources and evaluation of possible health effects

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Version: 2 **Date:** 16 October 2009

Author's response to reviews: see over

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Hannover, 11. May 2009

Dear Sir or Madam,

we had uploaded the revised manuscript of our research article. Attached to this cover letter you will find our comments giving a point-by-point response to the reviewer concerns.

Please don't hesitate to contact me if you have any questions regarding our manuscript or comments.

Best regards
Stefan Hahn

Editor

In addition to the reviewer comments, we request the following formatting issues be made and submitted with your revised manuscript:

- Please remove the page numbers.

→ revised as recommended

- In general the word order and choice of vocabulary in places is awkward. Please reread the manuscript carefully as all the issues have not been mentioned below.

→ the authors as well as a native speaker had reread and revised the manuscript

- The phrase worst-case is used repeatedly in the text, though the common phrase in English is worst case scenario. Consider changing this to worst case scenario approach without the hyphen.

→ revised as recommended

Additionally, in-can preservation is not a phrase used in English. Please find a suitable alternative phrase.

→ in-can preservatives is the official naming within the BPD for biocides applied in product type 6 to prevent bacterial or fungal growth in e.g. container or canister. In-can preservation is used often in product information (also from US companies).

- Please remove the bolding throughout the text.

→ revised as recommended

- On page 2, "the" should be placed before active in the first paragraph; the parenthesis around on-site in the Methods section of the abstract are not necessary; internet should not be capitalized; in the third sentence of the Methods section, the phrase after the semi colon does not made sense; the abbreviation TGD is not explained, please spell out the acronym; and thereof in the fifth sentence of the Methods section is awkward.

→ revised as recommended

- Numbers 0-9 should be written out e.g. on page 3, by a factor of three.

→ revised as recommended.

The sentence continued at the top of page 3 from page 2 is not clear. Perhaps moving the phrase on average by a factor of three after exposure would clarify.

→ revised as recommended

- Please move the Background section on page 3 to the top of the next page.

→ revised as recommended

- On page 3, the first two sentences in the Background read like the same sentence rewritten. In the third and fourth sentences, notified does not read as the correct term nor does dossiers.

→ revised

- At the bottom of page 4, The second the last sentence is awkward and a run-on sentence and the last sentence is a run-on.

→ To make it more clearly the sentence has been revised as follows:

Therefore the relevance of the biocides used in household products was investigated in a project sponsored by the German Federal Agency on the Environment (project period 15.10.2004 – 30.11.2005). In this project the content of biocides in consumer products was investigated. Then, the overall exposure to individual biocidal active substances from consumer products was modelled using a worst-case scenario approach. Finally, the toxicological data were evaluated, and the potential health risks were assessed.

- On page 5, in the first sentence of the Methods section, please insert and after the comma and before assessing.

→ revised as recommended

- On page 8, in the second paragraph, incl. should be spelled out and remove the spaces around the /.

→ revised as recommended

- On page 9, icaridin, ethyl and diethyltoluamide all have lower case first letters.

→ revised as recommended

- The references like those found on page 15 should be listed in one set of brackets if they are next to one another e.g. [9, 22, 23, 24]. The etc. should be removed.
- we have revised as follows: ... for chlorpyrifos such as [9, 22, 23, 24] and for dichlorvos such as [7] ...
- On page 15, on the top of the page please write out the terms as ConsExpo and SprayExpo, remove the parenthesis, leave the references and their brackets and insert and between them e.g. ConsExpo [14] and SprayExpo [15].
- we have revised as follows: ... such as ConsExpo [14] and SprayExpo [15] ...
- Please see the Instructions for Authors for guidance of the formatting of the references section. The issues should be removed and the journals italicized. The references that are not cited in the manuscript should be removed.
- revised as recommended. We have checked the references: references 1-25 are cited in the text, references 26-31 are cited in table 5
- The figure heading should move moved to its own page.
- revised as recommended
- The tables should be closed cell formatting so that the horizontal and vertical lines are all visible. The additional files will be linked into the final published article in the form supplied by the author, but will not be displayed within the paper. They will be made available in exactly the same form as originally provided.
- revised as recommended

Reviewer 1

Major Compulsory Revision:

- 1) in the conclusion it is stated that the study does not have added value, since in the near future more detailed assessments become available (reviewers interpretation).

In my opinion, the conclusion must be more focussed, e.g. on the use of refined models, or on the importance of aggregate exposure assessment, or on the irritating or sensitizing substances. Now, when only reading the conclusion, I wonder why this study is considered worthwhile for publication, whereas when the critical points are better identified, this publication might be useful for risk assessors of biocidal products.

→ We have extended the conclusion also based on the comments made by reviewer 2

- 2) The terms hazard and risk are not used consistently used throughout the document. For instance on page 5, first sentence last word should be risks instead of hazard (or it should be: classifying hazard, and assessing risk). Also on page 14: 'This is of minor importance, for the assessment of the health RISK (instead of hazard). On page 14, just below discussion: the health RISK (instead of relevance)

→ revised as recommended

- 3) Page 10: there were some modifications to the algorithms of the TGD. It is not clear what these modifications were (fugacity and conc limited to max amount or also other?)

→ For inhalation exposure the TGD algorithms has been used ($c=m/V$). The concentration in air has been limited by using the ideal gas law (similar to ConsExpo). In addition, in some cases fugacity has been used instead of vapour pressure to describe more precisely the distribution between liquids and gases. Finally, the concentration has been limited to max amount used. However, this is still only a rough estimation. A tier 2 approach using for example evaporation rate (ConsExpo) will result in lower values.

→ we added after modifications "(limited to maximal possible concentration in air using ideal gas law and fugacity, limited to maximal amount used)"

- 4) Page 13: It is not clear how the overall MOEs are calculated (they are not just summed up). Please explain

→ First the total exposure value of each scenario has been calculated by summing up the exposure values of inhalation, dermal and oral. In cases the max amount used will be absorbed both by inhalation and dermal, the total exposure value for each scenario has been limited by using the max amount used. After that the respective aggregate exposure value for inhalation, dermal, oral and total has been

calculated by summing up the exposure values of the scenarios. The aggregate values have been used for the total MOEs. In addition, for some compounds different NOAELs have been used for total (equally to oral) and dermal or inhalativ.

Therefore, summing up the individual exposure values (of inhalation, dermal and oral) or MOEs (for inhalation, dermal and oral) will not result in the same total values as presented.

→ We added footnotes to the tables 3 and 6 to explain the procedure

Minor essential revisions:

- 1) Suggestion to use aggregate instead of additive (page 2, last sentence)
→ revised as recommended. Additionally revised at further places in the text.
- 2) Page 3: chloroacetamide may be present (instead of used)
→ sometimes the products have to be diluted before use, and thus “present” will not be correct in each case. Therefore the sentence has been revised in “...may be present in household products or their ready-to-use solution...”
- 3) Page 4: the sentence: For exposure estimates.. is not clear. What is meant here? Exposure models?
→ revised to exposure models, due to the fact that in the TGD and the TNsG only the models (or default values) are described not the estimates
- 4) Page 4: please do not use the term consumption data (data on product use?)
→ revised as recommended
- 5) Page 6, first sentence: maximum allowed concentrations
→ revised as recommended
- 6) Page 6: what is the difference between wide range of applications .. and.. use in a variety of products
→ the wide range of application is more the type of application (disinfectant, preservative); the variety of household products is the occurrence in different products (of the same application).
Nevertheless we have deleted the second sentence to prevent the lack of understanding.
- 7) Page 6: last sentence: frame formulations (i.e. instead of e.g.)
→ revised as recommended
- 8) Page 7: why was 100% absorption assumed, even in the case of more adequate data? why was mouthing behaviour not taken into consideration?
→ for inhalation the absorption was set to 75%; 100% absorption was assumed for dermal and oral route. The approach was to make only a screening, and to compare different active substances. Both was only applicable in the case with 100% absorption.
→ We have not considered all mouthing situations as well as exposure via house dust, as the exposure situation is very complex and the parameters (e.g. number of mouthing) will vary very largely. However, the oral route has been considered for some scenarios. In addition, for the case of licking hands which had contact with disinfected areas or cosmetics we have considered mouthing indirectly by assuming 100% dermal absorption.
→ Therefore, we have revised the description of the exposure modelling and explained the approach in more detail.
- 9) page 7: also NOAECs taken into account (for inhalation?)
→ no, the exposure was calculated as body dose (to be able to add exposure from different sources and to account for duration of exposure).
- 10) Page 9: sentence: Here, mainly zinc pyrithone, triclosan.. (triclosan is mentioned twice)
→ one triclosan has been deleted
- 11) Page 9: do not understand the sentence: no definite statement...
The relevance of objects for the overall exposure?
However, as seen in the conclusion, this statement can also not be made for other products.
→ We do not clearly understand the question. We could not find meaningful data for antimicrobially finished objects such as toilet seats, so that a statement for this group is not feasible. It is right, that as we had done only a screening, a definite statement for all products is not possible.

In conclusion, we deleted "definite", so that it is only written "No statement can be made about...". We hope that makes it more general.

12) Page 10: Please delete the sentence: for all active substances there is a high degree of dermal exposure if.... (this is too obvious, especially when 100% dermal abs. is assumed)

→ Sentence was deleted.

Reviewer 2

Major Compulsory Revisions:

The intention of the following comments is to urge the authors to use their excellent research to develop stronger conclusions and recommendations to improve environmental health.

There are benefits to developing a portion of a larger EU effort into a separate journal article:

- 1) focus on the exposure assessment, independent of the risk assessment, makes it possible to consider recommendations based on exposure.
- 2) the authors can make conclusions and recommendations that may be beyond the scope of the full EU report.

The authors identify numerous hazardous biocides that are ingredients of every day consumer products including those in toothpaste, body washes that people put all over their skin, hair products that are left on for days, as well as home improvement products and pesticides used in the home. They find that a number of these products have serious health effects, including some that are sensitizers at or near concentrations that consumers may be exposed to. They also identify spraying as a particularly hazardous method of application for products containing biocides.

These findings merit a more critical analysis of their implications for protecting human health and the environment. The authors are strongly encouraged to be more direct about making recommendations to reduce or eliminate the exposures they have identified. These recommendations would not preclude proceeding with the larger EU risk assessment, however this reviewer's concern is that the exposure assessment will not be used to take preventive action but instead will be buried waiting for the risk assessment. The findings of this research raise the question: Why are these numerous hazardous substances in personal care and other consumer products? The authors do not need to answer why this is, but they should raise the question for environmental health policy makers and consumers to consider. Perhaps we need biocides in some products, but do we need biocides in toothpaste? Sports clothing? Hair products? What is the scientific basis for using biocides in consumer products? Do criteria exist to determine whether they are effective? In addition, there is some evidence that these biocides may be fostering the growth of biocide-resistant micro-organisms when they enter water through the waste water treatment system. It would be very useful if authors could make recommendations to scientists, government agencies, and consumers about the need for alternatives that are less hazardous. In this paper, they have identified some less hazardous biocides; are there other alternatives? Regarding the hazards of spraying biocides: Can a recommendation be made that biocides not be put in consumer products that are aerosolized? Overall, how should the findings of this research be used (beyond being an essential component of a risk assessment)? These topics should be addressed in the discussion and conclusions and summarized in the abstract.

In the introduction to the paper, a statement regarding the broad goal of the research should be added.

→ This is a very helpful comment. Originally, we have focussed on the scientific outcome, but agree that it is worth to mention at least some of the general issues and consequences. Therefore we have added some text in the Background, the Results and the Conclusion.

Minor essential revisions:

Page 7, last paragraph, Sentence beginning: "To assess the systemic effects..." the order of the words Effect and Adverse should be reversed to read "No Observed Adverse Effect Level."

→ revised as recommended

Page 9, last paragraph, sentence beginning: "Here, mainly zinc..." triclosan is listed twice.

→ one triclosan has been deleted

Figure 1, needs a legend to explain the abbreviations.

→ the abbreviations (UBA, PC) have been written out, so that a legend is not necessary anymore

Discretionary Revisions:

How widely distributed are these products beyond Germany? Are they available throughout Europe?

Other parts of the world?

→ These products are generally available in Germany and presumably also in many countries in Europe.