



JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEx COMMITTEE ON NUTRITION AND FOODS FOR SPECIAL DIETARY USES

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DISCUSSION PAPER ON METHODS OF ASSESSING THE SWEETNESS OF CARBOHYDRATE SOURCES IN THE STANDARD FOR FOLLOW-UP FORMULA (CXS 156-1987)

(Prepared by the electronic Working Group chaired by the European Union and co-chaired by Switzerland)

Introduction and Background

Discussion at CCNFSDU43

1. CCNFSDU43 completed the work on updating the *Standard for follow-up formula for older infants and product for young children* (CXS 156-1987) (hereafter referred to as the Standard for follow-up formula), which was adopted at CAC46. The Standard requires that “Lactose should be the preferred carbohydrate in the product as defined in Section 2.1 based on milk protein. For products based on non-milk protein, carbohydrate sources that have no contribution to sweet taste should be preferred and in no case be sweeter than lactose” (see footnote 4 of 3.1.c) of Section B). CCNFSDU43 also agreed to continue work in order to identify appropriate methods for assessing sweetness of carbohydrate sources (sweet taste) in Section B (Drink for young children with added nutrients or Product for young children with added nutrients or Drink for young children or Product for young children).
2. During CCNFSDU43, an in-session WG discussed the issue and recommended that the Committee:
 - Establish an EWG to review and identify and, if appropriate, recommend methods for referral to CCMAS for endorsement and typing, in particular ISO 5495, for assessing the sweetness of carbohydrate sources in comparison to lactose in “Product for Young Children” [in line with section B footnote 6⁽¹⁾ for those products with non-milk protein, point 3.1 of the new Standard].
 - The approach described in CRD16 regarding assessment of sweetness by the EU and Switzerland should be taken as a starting point.
3. CCNFSDU43 noted support for the recommendation along with the following views:
 - The EWG should collect scientifically available methods for use in sensory evaluation in the target age group (i.e. 12-36 months).
 - The preferred methods would be those based on comparison with lactose.
 - The ratio between lactose and glucose polymers in terms of how sweetness will be measured could be explored.
 - Concern was expressed about the use of flavourings and potential impact on sweetness.
4. CCNFSDU43 endorsed the recommendation of the in-session WG and agreed to establish an EWG, chaired by the EU and co-chaired by Switzerland, with the following terms of reference (para 128):
 - i. To review, identify and, if appropriate, recommend methods for referral to CCMAS for endorsement, in particular ISO 5495, for assessing the sweetness of carbohydrate sources in comparison to lactose in “Product for Young Children” in line with the revised CXS 156-1987, Section B, point 3.1.3 c) footnote 6⁽²⁾, for those products based on non-milk protein.
 - ii. The approach described in CRD16 of CCNFSDU43 by the EU and Switzerland should be taken as a starting point.
 - iii. To submit a report for discussion at CCNFSDU44.

¹ in the revised standard footnote 4

² in the revised standard footnote 4

Discussions at the previous sessions

5. CCNFSDU41 (2019) agreed to revise the Standard for follow-up formula (FUF; Section B: drink/product for young children with added nutrients/drink for young children i.e. FUF 12-36 months), specifying that “for products based on non-milk protein, carbohydrate sources that have no contribution to sweet taste should be preferred and in no case be sweeter than lactose.” Furthermore, CCNFSDU41 agreed to ask CCMAS whether there were internationally validated methods to measure sweetness of carbohydrate sources for these products.
6. CCMAS41 informed CCNFSDU42 that there were no known validated methods to measure sweetness of carbohydrate sources and therefore no way to determine compliance for such a provision. This seems to be limited to the measurement of absolute sweetness and in the final product. In CRD22 CCNFSDU43, Switzerland clarified that a comparison of the sweetness between two ingredients (lactose and other carbohydrate sources) is an approach to test compliance with the provision; however, the question to CCMAS was not raised like that.
7. The International Organization for Standardization (ISO) noted in CCNFSDU42 (Para 91 REP22/NFSDU), that there were some ISO methods to do a comparison. ISO further clarified that it was possible to compare the sweetness of lactose with the sweetness of another carbohydrate source, but only if this carbohydrate source is alone, diluted in water.
8. The Codex Secretariat clarified that although methods recommended by Codex normally refer to the finished product, they could also refer to ingredients.
9. The Chairperson noted that it was preferable, but not a requirement, that a method(s) should be endorsed by CCMAS and included in *Recommended methods of analysis and sampling* (CXS 234-1999) so that a common method can be used to enforce the provision.
10. CCNFSDU42 agreed to retain the provision. Furthermore, CCNFSDU42 agreed to consider appropriate methods for assessing conformity to the provision and possible endorsement by CCMAS at its next session.

Participation and Methodology

11. Codex Members and Observers were invited to register (by 1 September 2023) to participate in the EWG. Twenty-two (22) Members and nine (9) Observers registered for the EWG³. A list of participants can be found in Appendix II.
12. The EWG completed one round of consultation, seeking answers to five questions related to the proposed method, which was circulated by the chair and co-chair, in English, to the EWG on June 17, 2024. Responses and comments were requested by July 16, 2024.
13. The consultation received thirteen (13) responses from eight Codex Members and five Observers.

Summary of the consultation

14. In order to re-submit a request to CCMAS to endorse a method, in particular the ISO 5495 Sensory analysis – Methodology – Paired comparison test to measure sweetness of carbohydrate sources relative to lactose for drink/product for young children with added nutrients or drink/product for young children, the issue was further discussed in this EWG.
15. While ISO5495 has not been specifically validated for the assessment of relative sweetness of a carbohydrate ingredient against lactose as a reference, this kind of sensory testing is widely applied in the food industry and has found general acceptance as a sensory test to choose the sample that is perceived higher in the specified sensory attribute.
16. In addition, both sensory evaluation / sensory panel test are being used in Codex, e.g. in all Codex standards for fish and fishery products, which prescribe the use of CXG 31-1999 (*Guidelines for the sensory evaluation of fish and shellfish in laboratories*) and the *Standard for olive oils and olive pomace oils* (CXS 33-1981).
17. Codex Members but one, generally supported the work of the EWG and found it useful. Regarding the questions raised, one Member expressed that the ISO 5495 method can be used to compare the

³ Argentina, Brazil, Germany, Guatemala, Honduras, India, Indonesia, Iran, Japan, Mexico, Morocco, Nigeria, Panama, Poland, Republic of Korea, Saudi Arabia, South Africa, Switzerland, Thailand, Uganda, United Kingdom, United States of America, AOAC INTERNATIONAL, Calorie Control Council (CCC), EU Specialty Food Ingredients (EUSFI), Food Industry Asia (FIA), International Council of Beverages Associations (ICBA), International Council of Grocery Manufacturers Association (ICGMA), International Dairy Federation (IDF), International Special Dietary Foods Industries (ISDI), UNICEF participated in the EWG.

sweetness of lactose with that of another carbohydrate source when diluted in water. While issues concerning the assessment of carbohydrates sweetness in the final product should also be considered by the Committee, it is crucial to advance the discussion on applicable methods. Additionally, it was recalled that the Codex Secretariat clarified that although Codex-recommended methods typically apply to the finished product, they could also be relevant for ingredients. Moreover, the provision mentioned in footnote 4 of CXS 156-1987 explicitly refers to ingredients. Therefore, the proposed method could be submitted to CCMAS for evaluation to determine its suitability for testing compliance with the provisions outlined in CXS 156-1987, Section B: Drinks/Products for Young Children. CCMAS, as the responsible Committee, will assess whether the method aligns with the principles for establishing Codex Methods of Analysis and evaluate its suitability for assessing the relative sweetness of carbohydrate sources in comparison to lactose for non-milk protein-based products.

18. Three Observers questioned the selection of the 2-fold concentration in the proposed protocol without any validation data provided to support this procedure. The question to be answered in this case is independent of the maximum permissible concentration in the final product. Differences between two solutions in the near-threshold range may be less detectable than at higher concentrations.
19. Two Observers highlighted that the method itself was not problematic, but its mode of application in the current context, questioning generally the requirement in footnote 4 of the *Standard for follow-up formula* (CXS 156-1987) and noting that the method was not assessing sweetness in the final product.
20. A summary of the responses to the questions posed during the consultation is provided in Appendix I to this report.

Conclusion of the EWG

21. There was general support from many countries of different regions of the world for the proposed method, preparation protocol and reference values for assessing the sweetness of carbohydrate sources in comparison to lactose in "Product for Young Children" in line with CXS 156-1987, Section B, point 3.1.3 c) footnote 4, for those products based on non-milk protein, general support to refer the method to CCMAS. Observer Organisations expressed disagreement on the proposed method. It is worth to note that disagreement of Observer Organisations relates generally not to the method itself, but object to footnote 4 of CXS 156 -1987, although CXS 156-1987 has been adopted with footnote 4. The Chair and co-Chair of the EWG propose to submit the method to CCNSFDU44 for discussion and consultation of CCMAS.

Recommendations of the EWG

22. CCNFSDU44 is invited to consider referring the method below to CCMAS for endorsement and inclusion in the *Recommended Methods of Analysis and Sampling* (CXS 234-1999):

Commodity	Provision	Method	Principle	Type
Foods for special dietary uses				
Follow-up formula, Section B: Drink for young children with added nutrients or Product for young children with added nutrients or Drink for young children or Product for young children	Carbohydrates (based on non-milk protein)	ISO 5495 The relative sweetness of a carbohydrate ingredient shall be measured by comparing a sample solution prepared with 17.50 g carbohydrate in 100 ml water ⁴ with a reference solution of 17.50 g lactose in 100 ml water ⁵ at 20 to 22°C. When the carbohydrate ingredient solution is rated sweeter than the lactose solution by a trained sensory panel ⁵ , the carbohydrate source does not comply with the provision.	Sensory test	IV

⁴ neutral, tasteless, still, odourless and preferably with low mineral content

⁵ ISO 8586 – Sensory analysis – General guidelines for the selection, training and monitoring of selected assessors and expert sensory assessors; and ISO 3972 + Cor. 1 – Sensory analysis – Methodology – Method of investigating sensitivity of taste shall be used for the selection, training and qualification of sensory assessors.

For the implementation of the standard ISO 5495 the following default values for α -risk, β -risk and p_d should be applied to achieve minimal statistical precision:

- α -risk: 0.05⁶,
- β -risk: 0.05⁷,
- p_d : 50%⁸.

⁶ If α -risk is 0.05, there is a 5% likelihood of inaccuracy

⁷ If β -risk is 0.05, there is a 5% likelihood of inaccuracy

⁸ p_d , the proportion of the population of subjects who are able to distinguish between the two samples

Summary of responses to the questions

Question 1) “Do you agree with the proposed method DIN EN ISO 5495:2016 – Sensory analysis – Methodology – Paired-comparison for the comparative assessment, to measure the relative sweetness of the carbohydrate ingredient against lactose as a reference material?”

1. All but one Members agreed or supported submitting the proposed method to CCMAS for evaluating its suitability for the intended purpose and for possible endorsement and typing. They recommended that CCMAS should be requested to provide further guidance on the applicability of this method for the Paired-comparison for the comparative assessment for “Drink for young children with added nutrients or Product for young children with added nutrients or Drink for young children or Product for young children” (Part B of the *Standard for follow-up formula* (CXS 156-1987). CCMAS should also assess whether the method aligns with the principles for establishing Codex Methods of Analysis and, if needed, recommend to CCFSDU further issues that need clarification and/or refinement.

2. Some Members stressed that the method has been extensively discussed and that there are no known validated methods to measure sweetness in the final product. However, measuring and comparing the potential sweetness of carbohydrate ingredients against the sweetness of lactose is the closest approximation that can be done with reasonable effort and precision. This approach can help to achieve an overall low level of sweetness in the final product. Furthermore, it was also expressed that it is crucial to advance the discussion on applicable methods.

3. One Member stressed that issues concerning the assessment of carbohydrates’ sweetness in the final product should also be considered by the Committee. Even though, the Codex Secretariat has already clarified that although Codex-recommended methods typically apply to the finished product, they could also be relevant for ingredients (REP22/NFSDU), and therefore acknowledged that the proposed method could be submitted to CCMAS to determine its suitability for testing compliance with the provisions outlined in CXS 156-1987).

4. Most Observer Organisations and one Member did not agree with the proposed methods, mainly by referring to the [CRD06](#) submitted to the CCFSDU42. They highlighted that the method itself is not posing a problem, but its mode of application. Another concern was that the method does not measure sweetness in the final product and that Part B of the *Standard for follow-up formula* (CXS 156-1987) already limits mono- and disaccharides up to 2.5 g/100 kcal in the product and provides further provisions for carbohydrates sources.

Question 2) “Do you agree with the proposed preparation protocol?”

5. There was a general agreement among Members with the proposed preparation protocol. It was explained that the rationale for using twice the concentration of lactose allowed in the final product to improve the reliability of the sensory test of the ingredients is feasible. As the relationship between sweetness intensity and concentration is not linear; therefore, using twice the concentration might lead to different results in sweetness once the actual amount of the carbohydrate is used in the final product. However, this could be acceptable, as the overall method is an approximation with respect to the final sweetness in the product. Furthermore, the importance that the test carbohydrate should be soluble at the testing temperature of 20-22 °C was also stressed.

6. Most (4) Observer Organizations did not agree with the general approach of assessing sweetness of carbohydrate sources against lactose. A reference was made to the special report of the AOAC INTERNATIONAL Ad Hoc Expert Panel on Sweetness (November 2020) “The Challenge of Measuring Sweet Taste in Food Ingredients and Products for Regulatory Compliance: A Scientific Opinion”, which highlights that sweetness perception testing is difficult due to the absence of a reference value for sweetness intensity and other factors such as temperature and sample concentration. Another remark was made that the protocol does not take into account the modulation of the sensory properties in the complex matrix of the final product by manufacturing processes such as thermal processing and by the other ingredients in the finished product. Three Observer Organisations raised concerns with the doubled concentrations, i.e. at 17.5 g/100 ml for the carbohydrate source and lactose, in the test solutions presented to the assessors, since linearity of sweetness perception cannot be assumed without validation data provided to support this procedure.

Question 3) “Do you agree with the proposed reference value for α -risk, β -risk and p_d ?”

7. There was a general agreement among Members with the proposed reference value for α -risk, β -risk and p_d , explaining that in a setting with medium sensitivity, the proposed values are standard and that adequate justification was provided by referring to the ISO 5495:2016 standard.

8. Most (4) Observer Organisations did not agree with the proposed reference values, as they did not agree with the proposed method or the provision in the Codex Standard generally. Two Observer Organisation expressed that the proposed reference values listed include commonly used values for α -risk and β -risk at 0.05, meaning that there is a 5% chance of inducing a type 1 or type 2 error in the analysis, and that this is considered a relatively high level of accuracy and should be appropriate. The feasibility of the approach was questioned as it was noted based on the methods and following ISO protocols, that following the ISO standard and the proposed risk levels requires a panel of 49 (two-sided test) or 42 (one-sided test) panellists to assess compliance of a carbohydrate source with the proposed provisions. The difficulty of having access to such a large panel and maintain its performance over time was emphasised.

Question 4) “Do you have any specific suggestion to refine the proposed method?”

9. To further refine the proposed method, it was suggested by one Member that

1. **Samples of different concentration**, instead of using a single concentration of carbohydrate ingredients, should be used. This will make it possible to obtain a dose-response curve and better understand the relationship between concentration and sweet taste perception.
2. **Repeats** of the assessment with several independent sensory panels to reduce inter-individual variations. Several repetitions will improve the reliability of the results.
3. **Control of the temperature** of the solutions because it must be constant during the evaluations. Temperature variations can affect taste perception.

Assessing persistence time by asking tasters to note the length of time of sweet taste persists after tasting. This can reveal subtle differences.

10. One Observer Organisation highlighted that it is not the problem of the method itself, but its mode of application in the current context. Another Observer Organization considered that the method is not applicable for the ultimate purpose of limiting sweetness of the final product on the basis of the points listed in CRD16 - modulation of the sensory properties in the complex matrix of the final product by manufacturing processes such as thermal processing and by the other ingredients in the finished product.

Question 5) “Could you identify any other methods for assessing sweetness of carbohydrate sources in comparison to lactose for products based on non-milk protein?”

11. One Member recommended to combine sensory methods with methods for calculating nutritional values, particularly sugar content. Also taste databases are relevant tools measuring the intensity of the sweet taste of foods.

12. Another Member referred to the promising concepts in the literature, such as using novel digital technologies that combine electronic sensors (e.g. e-tongue) with artificial intelligence. Also, it might be highly interesting to combine these novel digital technologies with methods quantifying the carbohydrate content in food. Overall, these techniques might not yet achieve the necessary precision; however, research is ongoing, and therefore, such techniques might be of interest in the future. The Member considered that at present stage, they deem the proposed method (ISO 5495:2016) the most feasible for enabling the measurement and restriction of sweetness in carbohydrate sources for products for young children.

13. Another Member recommended the GB5009.8–2023 method as applicable to determine the content of fructose, glucose, sucrose, maltose and lactose in foods.

LIST OF PARTICIPANTS**Chair**

European Union

Co-chair

Switzerland

Codex Members

Argentina

Brazil

Germany

Guatemala

Honduras

India

Indonesia

Iran

Japan

Mexico

Morocco

Nigeria

Panama

Poland

Republic of Korea

Saudi Arabia

South Africa

Switzerland

Thailand

Uganda

United Kingdom

United States of America

Observer Organisations

AOAC INTERNATIONAL

Calorie Control Council (CCC)

EU Specialty Food Ingredients (EUSFI)

Food Industry Asia (FIA)

International Council of Beverages Associations (ICBA)

International Council of Grocery Manufacturers Association (ICGMA)

International Dairy Federation (IDF)

International Special Dietary Foods Industries (ISDI)

UNICEF