



**JOINT FAO/WHO FOOD STANDARDS PROGRAMME  
CODEX COMMITTEE ON FISH AND FISHERY PRODUCTS**

**Thirty-sixth Session**

**Working by correspondence**

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**ELECTRONIC WORKING GROUP (EWG) REPORT ON THE PROPOSED AMENDMENT OF THE  
STANDARD FOR CANNED SARDINES AND SARDINE-TYPE PRODUCTS (CXS 94-1981) TO INCLUDE  
THE FISH SPECIES *SARDINELLA LEMURU* (BALI SARDINELLA) UNDER SECTION 2.1**

*(Prepared by the EWG chaired by Philippines and co-chaired by European Union [EU])*

**INTRODUCTION**

1. CCFFP35<sup>1</sup> established an Electronic Working Group (EWG), chaired by the Philippines and co-chaired by the European Union (EU), working in English, French and Spanish to evaluate if CXS 94-1981 could be amended to include the fish species *S. lemuru* (Bali *Sardinella*) in the list of *Sardinella* species under Section 2.1.

2. The following Terms of Reference (ToR) was agreed:

- (i) overseeing the sensory evaluation of the candidate species, i.e., *S. lemuru* in accordance with the inclusion procedure of the Procedural Manual, in particular Sections 2.3, 3.3, and 4;
- (ii) preparing a report to the CCFFP36 on its findings, conclusions, and recommendations.

3. CCFFP35<sup>2</sup> selected the following laboratories to perform the sensory evaluation:

- (i) Intertek ITALIA S.p.A., Intertek Sensory Laboratory, Via Grifoni 27, 62024 Matelica (MC), Italy;
- (ii) Portuguese Institute for the Sea and Atmosphere (IPMA), Rua Alfredo Magalhães Ramalho, n. ° 6, 1495-006 Algés, Portugal; and
- (iii) Aenor International, Calle Miguel Yuste 12, 4.ª Planta, 28037 Madrid, Spain.

Intertek ITALIA S.p.A was selected as the leading laboratory to coordinate the sensory evaluation and prepare the final report of the sensory evaluation.

4. On species to be compared with the candidate species *S. lemuru* in the sensory evaluation, CCFFP35<sup>3</sup> agreed to use the following species:

- (i) *Sardina pilchardus*, also known as European Pilchard;
- (ii) *Sardinella aurita*, commonly referred to as Round Sardinella; and
- (iii) *Sardinella maderensis*, recognized as Madeiran Sardinella.

In the absence of *S. maderensis*, *S. gibbosa* (Goldstripe Sardinella) would be an alternate species for *S. maderensis* in the sensory evaluation.

5. CCFFP35 considered various sample types for sensory evaluation. It was suggested that in addition to the proposed frozen whole fish, thawed whole fish, and cooked fish fillets, canned fish should also be included as the subject of the proposed amendment concerns the *Standard for Canned Sardines and Sardine-Type Products* (CXS 94-1981). CCFFP35 noted that the decision would be further discussed by the EWG, once established.

<sup>1</sup> REP21/FFP, paras 40-43

<sup>2</sup> REP21/FFP, paras 29-30

<sup>3</sup> REP21/FFP, paras 34-35

## PARTICIPATION AND METHODOLOGY

6. A total of 40 participants from 13 Members (12 Member countries and the EU) initially enrolled as Members of the EWG named, CCFFP35-Sardine species.

7. An inception meeting was held virtually on 15 March 2022 chaired by the Philippines, which focused on the following:

- (i) ToR of the EWG as concluded by CCFFP35;
- (ii) proposed description of work and timetable. This information was made available on the EWG Codex platform including revisions;
- (iii) sampling and handling protocols; and
- (iv) sensory evaluation protocols based on the *Guidelines for the Sensory Evaluation of Fish and Shellfish in Laboratories* (CXG 31-1999).

8. The proposed “Sampling and Sensory Evaluation Protocol” was circulated among the EWG for feedback. Comments from participating EWG Members were generally supportive of the methods and procedures outlined in the proposal. Some Members also provided additional recommendations (as detailed in Appendix I), specifically:

- (i) to include sensory evaluation of the canned products in accordance with the *Standard for Canned Sardines and Sardine-Type Products* (CXS 94-1981);<sup>4</sup>
- (ii) to conduct RT-PCR analysis on the target species to ensure the identity of the samples to be tested was accurate; and
- (iii) to consult the participating laboratories on the procedures/protocols and good laboratory practices.

9. Following the discussions on the “Types of Samples to be Used for Sensory Evaluation” (Appendix II), the EWG supported that aside from the submitted frozen samples to be evaluated using CXS 94-1981, the inclusion of canned sardines packed in vegetable oil and brine solution, as the subject of the proposed amendment concerns the *Standard for Canned Sardines and Sardine-Type Products* (CXS 94-1981). In addition, the identities of the samples were confirmed using RT-PCR.

10. The sensory evaluation was carried out according to CXG 31-1999.<sup>5</sup> Panellists were selected from individuals with experience on assessment of fishery and marine products and trained based on ISO 8586:2012. A summary of the procedure conducted by the three laboratories can be found in the Experimental Design for Sensory Evaluation of Sardines report from Intertek Italia while the results of the training are included in their individual training reports (Annex I, A-C).

11. The assessment of the visual characteristics was carried out by specialized technicians with experience on fish products. The designated assessors were responsible for the analysis of the remaining parameters.

12. The selected laboratories operated in accordance with CXG 31-1999 and ISO 8589:2007 which used separate preparation and testing areas. Sensory booths were equipped with water lines and white light in order to aid proper evaluation of samples (Annex II).

13. The collection of *S. lemuru* samples was conducted by the National Fisheries Research and Development Institute (NFRDI) of Philippines. AENOR Laboratorio, Spain collected samples for *S. maderensis* and *S. aurita* and Instituto Português do Mar e da Atmosfera (IPMA), Portugal collected samples for *S. pilchardus*. The methods for the collection of sardine species were based on the agreed Terms of Reference (ToR) and further details are provided on the fishing report (Annex III, A-C).

Sampling Details	<i>S. pilchardus</i>	<i>S. aurita</i>		<i>S. maderensis</i>	<i>S. lemuru</i>		
Date of Collection	Oct 25, 2022	Nov 14, 2022	Dec 14, 2022	Dec 14, 2022	Apr 24, 2022	Oct 15, 2022	Oct 23, 2022
Collection Site	Northeast Atlantic -	Atlantic Ocean		Canary Island	Ticao Pass, Southern Luzon Island		

<sup>4</sup> CXS 94-1981

<sup>5</sup> CXG 31-1999

	Portuguese waters						
Volume of Catch, kg	52	45	45	45	12	18.5	51
Average weight per piece, g	50-62.5	260	50.4	321	39.4	38.8	42.2
Average length per piece, cm	18-20	30	18	34	16.5	17.6	17.6

14. Following the decision to include canned sardines, the EWG agreed that a technological center or company should perform the canning process and should be carried out under the same processing conditions (raw material, cooking, sterilisation, oil, etc.). The EWG accepted IPMA's offer to organize the canning process, ensuring that products derived from different species would be processed in a uniform way. COFISA - Conservas de Peixe da Figueira (COFISA) was tasked to perform the canning process on a commercial scale. The EWG also agreed that the canned products should have brine and vegetable oil as packing media (Appendix II, Annex IV).

15. Sensory evaluation process included conducting a Quantitative Descriptive Analysis (QDA) following the ISO 13299:2016 (Sensory analysis – Methodology – General guidance for establishing a sensory profile). This analysis was performed on frozen, thawed, cooked and canned sardines in brine and in vegetable oil (Annex V).

16. The QDA process involved a structured and controlled evaluation, where the assessors employed the defined set of descriptors to assess various sensory attributes such as appearance, aroma, taste, and texture.

17. The different sardine sample states (frozen, thawed, and cooked) were prepared based on CXG 31-1999. The evaluation of frozen samples was conducted based on their visual appearance in their natural state. Subsequently, after the assessment of frozen samples, the fish specimens were thawed under refrigerated conditions (2-6°C) until a partially frozen state that is suitable for filleting was reached. Each fish yielded two fillets, one was immediately evaluated after thawing, while the other was stored at 2-6°C, for steaming. The steamed samples were prepared by individually wrapping each fillet in aluminium foil and were cooked at a fixed temperature to reach an internal temperature of 70°C.

18. Despite the insufficient quantity of *S. maderensis*, the EWG decided to proceed with the sensory evaluation of frozen, thawed and cooked samples based on discussion dated July 5, 2022, "Type of Samples for Frozen, Thawed, and Cooked Conditions" (Appendix III). The sensory evaluation of canned sardines was deemed to be more important, thus *S. maderensis* samples were prioritized to be used for the production of canned sardines for sensory evaluation. The laboratories considered that this decision did not affect the conclusion of the reports.

19. The Sensory Analysis for Frozen, Thawed, and Cooked was carried out as per CXG 31-1999 by all the laboratories. For visual analysis, i.e. skin integrity and discoloration of the spine, the number of assessors differed slightly between the laboratories, as it was carried out by specialists in this evaluation. The rest of the parameters were analyzed by the same number of assessors. The lead laboratory confirmed that these differences in the number of assessors had no impact on the study as no discrepancies were found in the visual parameters. Differences between the species were mainly encountered in the taste, smell, and texture (Appendix IV).

20. One-way Analysis of Variance (ANOVA) was used to determine if there are significant differences between the scores of the trained assessors followed by Fisher's Least Significant Difference (LSD) test for pairwise comparison if significant difference exists using XLStat Software.

21. Molecular analysis of the canned sardines was performed by IPMA. DNA barcoding method, which involves extracting DNA from tissue samples, was applied for genetic identification of fish species. Due to the difficulty in achieving successful amplification and obtaining a complete cytochrome c oxidase subunit I (COI) with the canned samples, another method was used which was massive fragment sequencing of markers cytochrome b (Cytb) and COI using Next Generation Sequencing (NGS). The DNA extraction was conducted using the commercial Kit Machery-Nagel nucleospinood. Fragments of the Cytb and COI genes were amplified

and massively sequenced with NGS Thermo Fisher platform using the kit Ion PGM Hi-Q view sequencing (Annex VI).

22. On the sustainable management of the stocks of *S. lemuru* in the natural environment, members and observers of the EWG, and in particular sardine-producing countries, were invited to provide information on Management Plans aiming at ensuring the sustainable management of the stocks of *S. lemuru*. This included available information on predictive dynamics of *S. lemuru* population and how the stocks could be affected by higher fishing pressure that could result from its inclusion in the Codex standard (Appendix V).

## SUMMARY OF DISCUSSION

### Canned sardines

23. The sensory evaluation of canned Sardines (*S. lemuru*, *S. aurita*, *S. pilchardus*, *S. maderensis*) in brine and oil reveals consistent findings. All samples exhibit typical odors and flavors without defects such as metallic, rancid, or fermented notes. The consistency aligns with the product typology specified in Annex VII (Tables 3-6 for brine and Tables 8-11 for vegetable oil). However, *S. maderensis* in brine and vegetable oil stands out due to significant differences in fish dimensions compared to *S. lemuru*, *S. aurita*, and *S. pilchardus*, influencing its consistency assessment.

24. The canned sardines in brine and in vegetable oil can be considered free of attribute defects. The attributes of typical characteristics of odour and flavour of canned sardines in vegetable oil and brine can be considered in line with the trend of the type of product. The sensory attributes of *S. pilchardus*, *S. aurita* and *S. lemuru* can be associated in the same cluster of characterization about visual, smell, taste, and consistency perception. The consistency of *S. maderensis* can be considered different from *S. lemuru*, *S. aurita*, and *S. pilchardus* due to the dimensions of the fish.

### Frozen, thawed and cooked sardines

25. The frozen *S. lemuru* exhibits a combination of characteristics that share similarities with *S. pilchardus* (Table 9 of Annex VIII).

26. In regard to thawed but uncooked fillets, there were, at a very low level, variations among certain descriptors (colour, cold storage/metallic/ drip loss). Nonetheless, the different species did not exhibit significant discrepancies from one another. Only for firmness, there were slight differences, especially for *S. lemuru* (Table 10 of Annex VIII).

27. Regarding cooked fillets, *S. lemuru* showed intermediate characteristics compared to *S. aurita* and *S. pilchardus* (Figure 3 of Annex VIII). *S. aurita* appeared to be the sardine most characterized by texture, with less firmness and more moistness.

28. The analysis of variance and F-test of the three laboratories show very little difference. It is important to highlight that all sensory panelists from the three laboratories worked in the same range of the scale (Tables 12, 13, and 14 of Annex VIII). All samples can be considered free of defect attributes. The typical characteristics of odour and flavour can be considered in line with the type of product. The sensory attributes of *S. pilchardus*, *S. aurita*, and *S. lemuru* were in the same cluster as regard to visual, smell, and taste. The consistency of *S. lemuru* can be considered slightly different from *S. aurita* and *S. pilchardus*, as less firm and moister.

29. The laboratory clarified that the organoleptic differences found between the different species in the thawed and raw states were not found on the final canned product since the process of canning affects the end product and reduces variations that may be found in the raw state.

### Molecular analyses

30. Samples of *S. maderensis* and *S. pilchardus* were successfully identified using Next Generation Sequencing (NGS). However, for the other samples it was not possible to distinguish *S. longiceps* from *S. aurita* and from *S. lemuru* using both Sanger Sequencing and NGS. Stern et al. (2018)<sup>6</sup> proposed the existence of only one species *S. aurita* after using two more markers. Thus, *S. aurita aurita* is proposed to be referred as the short head variant, synonymizing *Sardinella brasiliensis* and *S. lemuru*, while *S. aurita longiceps* may indicate the long head variant, synonymizing *S. longiceps* and *S. neglecta* (Appendix IV, Annex VI).

### Production and sustainability

31. In terms of production and sustainability, Fisheries Management Areas (FMAs) 4 (Zamboanga Peninsula) and 7 (Bicol) are pivotal for the sardine *S. lemuru* in the Philippines, contributing 81% of the total production over the last five years (2019-2023). FMA 4 dominates with 1,009,756 MT (69%), benefiting from management interventions like closed fishing seasons that have increased production volume and yielded

<sup>6</sup> <https://onlinelibrary.wiley.com/doi/epdf/10.1111/ecog.02755>

larger catches. Concurrently, FMA 7 produced 171,967 MT (12%), showing an increase in production value as well. Both FMAs use identified Reference Points (RPs) to manage fisheries effectively, focusing on metrics such as fishing mortality, spawning potential ratio (SPR), and biomass at maximum sustainable yield (B/B<sub>msy</sub>). Harvest Control Rules (HCRs) vary between FMAs, with FMA 4 emphasizing SPR to adjust fishing effort, while FMA 7 employs a broader set of RPs to regulate fishing capacity and protect juvenile stocks through zoning and seasonal closures. Hydroacoustic surveys indicate substantial biomass in both regions, underscoring their critical importance for sustaining *S. lemuru* populations despite differences in surveyed areas.

32. The Fisheries and Aquaculture Division of FAO pointed out that Bali Sardinella, *S. lemuru*, is a small-pelagic marine species widely distributed in coastal waters of the Eastern Indian Ocean and Western Pacific. It is an important fishery resource throughout its distribution area, being particularly important for commercial and subsistence fisheries in the Philippines. Like other tropical sardines, the Bali sardinella is characterised as having a short lifespan, fast growth rate, and high fecundity, making them more resilient to fishing pressure than other temperate sardine species. Available data on the status of sardine stocks in the main fishing grounds in the Philippines indicates that the species has been under high fishing pressure (exploitation rates (E) varying from 0.46 to 0.59 in the last two decades), with signs of decreasing production and sizes and in some areas<sup>7</sup>. The stock was considered maximally sustainably fished in the last FAO SOFIA assessment<sup>7</sup> of the state of stocks in the Western Central Pacific (FAO Area 71).<sup>8</sup> In the Philippines, fisheries management interventions have been adopted in national and regional fisheries management plans to ensure that stocks are exploited at their optimal biological potential and that the fishery can continue supporting livelihoods and contributing to the economy.<sup>9,10</sup>

33. While CCFFP's concern about sustainability aspects for *S. lemuru* is understandable, it is important to highlight that, according to data available to FAO, approximately half of the stocks of *Sardinella* species listed in the *Standard for Canned Sardines and Sardine-Type Products* (CXS 94-1991) are currently considered maximally sustainably fished and the other half overexploited. In this regard the situation of *S. lemuru* stocks cannot be considered of particular concern compared to other species in the list. Following the information from FAO, no further comments from the EWG Members were received.

## CONCLUSION

34. The Chairs of the EWG consider that the tasks as outlined in ToR have been achieved.

35. The Chairs of the EWG believe that CCFFP now is in the position to recommend the amendment of the *Standard for Canned Sardines and Sardine-type Products* (CXS 94-1981) to include *S. lemuru* in the list of *Sardinella* species under the Section 2.1.

## RECOMMENDATION

36. After having completed the tasks according to the Procedure for the Inclusion of Additional Species in Codex Standards for Fish and Fishery Products, the EWG recommends amending the *Standard for Canned Sardines and Sardine-type Products* (CXS 94-1981), to include *Sardinella lemuru* in the list of *Sardinella* species under Section 2.1, Product Definition.

<sup>7</sup> Campos and Bagarinao-Regalado, 2021.

<sup>8</sup> FAO, 2022

<sup>9</sup> NSMP, DA-BFAR

<sup>10</sup> Small Pelagics Fisheries Management Plan. Provincial Development Council of Zamboanga del Norte. Sangguniang Panlalawigan Resolution No. 902 series of 2022.

**APPENDIX I****SUMMARY OF DISCUSSIONS ON THE PROPOSED  
“SAMPLING AND SENSORY EVALUATION PROTOCOL”**

1. During the inception meeting held on March 15, 2022, the Electronic Working Group (EWG) on Fish and Shellfish Sensory Evaluation established and comprehensive protocols for sampling and sensory evaluation in accordance with international standards outlined in the *Guidelines for the Sensory Evaluation of Fish and Shellfish in Laboratories* (CXG 31-1999). These protocols were posted by the EWG, chaired by the Philippines and co-chaired by the European Union (EU), in the forum which aimed to ensure uniformity and accuracy in the assessment of fish species on March 16, 2022. The report presents the detailed procedures agreed upon for the sampling and handling of sardines.
2. To obtain representative samples, the Philippines collected three sets of 100 pieces (approximately 2 kg) of freshly caught sardines from the Mediterranean Sea to be submitted to the three chosen laboratories. The collected samples underwent species verification by a qualified biologist or fisheries expert. Only sardines of good quality, defined as those with minimal defects ( $\leq 10\%$  detached scales and deformities), were selected for further evaluation. The temperature of fish samples was maintained at 0 to 4 °Celsius upon its transport to the nearest Individual Quick Freezing (IQF) facility for blast freezing.
3. Handling of chilled fresh samples and IQF products within the food safety framework involved strict adherence to protocols established. Upon arrival at the IQF facility, the sardines were carefully removed from the foam box and transferred to colander trays. Internal temperature measurement was conducted again to confirm adherence to the required range of 0 to 4 °Celsius. The fish underwent triple rinsing with chilled water (0 to 4 °Celsius) before being arranged in stainless trays lined with polyethylene (PE) plastic. Subsequently, the trays were covered with PE plastic and subjected to blast freezing at -40 °Celsius until an internal temperature of  $\leq -18$  °Celsius was achieved, typically taking approximately 6 hours. Once frozen, the sardines were packed in PE bags (3 pieces per bag), placed in foam boxes with dry ice for preservation, and secured in carton boxes for transportation to courier facilities. It was imperative to confirm receipt of frozen sardines at the testing laboratory for further analysis.
4. Receiving and Storage of Frozen Fish Samples from the Philippines. *Sardinella lemuru* samples from the Philippines were received as individually quick frozen (IQF) shipments. Upon receipt, the frozen samples were stored at  $\leq -18$  °Celsius to maintain their quality and integrity until analysis is conducted.
5. The procedures stated in paragraphs 3 to 5 were repeated in three separate sessions to obtain three sets of results from three replications. One kilogram of samples was withdrawn from the storage facility for each session.
6. To initiate the analysis of frozen fish samples, the first step involved withdrawing one kilogram of samples from the storage facility, ensuring their representative nature. These frozen samples were then assembled in a clean tray for further evaluation. Using Quantitative Descriptive Analysis (QDA) with reference to the CXG 31-1999 guidelines, the samples were evaluated based on their appearance, including aspects such as the presence of freezer burn and colour variations. Following this assessment, the sensory evaluation results were decoded, and the data were interpreted in part II of the analysis. This systematic approach ensured thorough and accurate evaluation of the frozen fish samples, allowing for informed decision-making regarding their quality and suitability for consumption or further processing.
7. After the evaluation, the frozen samples were arranged on trays. They were then covered with a plastic bag to prevent drying and contamination or placed in a plastic bag and immersed in water until the thawing process was complete, maintaining a temperature range of 0-4 °Celsius. Once thawed, the heads and all internal organs were removed, and the fish fillets were separated. The thawed samples were assembled in a clean tray for further analysis. The samples were evaluated for their texture and odour using Quantitative Descriptive Analysis (QDA) in accordance with the CXG 31-1999 guidelines. Following the evaluation, the process proceeded to part III immediately. The sensory evaluation results were decoded, and the data was interpreted to provide a comprehensive assessment of the samples' quality and suitability for various purposes.
8. In the cooked state, the raw fish fillet was transferred and wrapped in aluminium foil following the evaluation process. These wrapped samples were then placed on a wire rack suspended over boiling water in a covered container. They were cooked until reaching an internal temperature of 65-70 °Celsius, ensuring not to overcook them. Subsequently, the cooked samples were evaluated for their odour, flavour, and texture using Quantitative Descriptive Analysis (QDA), referring to the CXG 31-1999 guidelines. The sensory evaluation results were then decoded and interpreted to provide a comprehensive understanding of the cooked fish samples' qualities.

9. A Member country supported the proposed procedures. Moreover, it was suggested having an agreement on whether the samples are thawed at ambient temperature covered with plastic bags, or immersed in water to accelerate thawing. Both are permitted under the *Guidelines for the Sensory Evaluation of Fish and Shellfish in Laboratories* (CXG 31-1999). Given the fish size and being IQF, the Member country considered ambient thawing would be relatively quick and should not result in spoilage.
10. In addition to the proposed procedures, another Member country recommended additional comments and details. The frozen state of the fish samples involved withdrawing one kilogram from the storage facility and measuring its core temperature, ensuring it did not exceed -18 °Celsius. For the thawed state, the procedure required covering the samples with a plastic bag to prevent drying and contamination. Alternatively, they could be placed in a plastic bag and immersed in cold water at a temperature of 21 °Celsius plus or minus 1.5 °(21°C ± 1.5°C). This immersion was carried out until the thawing process was completed, making sure the temperature did not exceed 0-4 °Celsius.
11. A Member country raised significant concerns regarding the proposed sampling protocol. It aimed to enhance the protocol ensuring its effectiveness in facilitating a reliable, accurate, and precise comparison between the participating laboratories. It also proposed measures to strengthen the sampling and sensory evaluation protocol which was already addressed by the three laboratories.
12. A Member country suggested the inclusion of canned products in the protocol.
13. Another Member country recommended conducting a thorough review by a biologist regarding the species used for sensory evaluation and the canned product. This review aimed to ensure the accuracy and reliability of the data gathered during the evaluation process. As part of this review, an RT-PCR analysis must be conducted.
14. A Member country supported the proposal for sampling and sensory evaluation protocols, noting that more information was required. This information could be provided by coordinating with the committed laboratories. Moreover, it expressed concern on the omission of protocol for the evaluation of canned sardines as it was deemed mandatory in accordance with the standard.
15. The posted agenda had 267 views in the forum.

**APPENDIX II****SUMMARY OF DISCUSSIONS ON THE PROPOSED  
“TYPE OF SAMPLES TO BE USED FOR SENSORY EVALUATION”**

1. Following the previous discussion, the EWG Chair initiated another thread addressing the preferred sample type for sensory evaluation, specifically whether to include canned products as suggested by a Member country.
2. A Member country supported the proposal not to include canned *Sardinella lemuru* in the sensory evaluation given the canning process can affect the sensory properties and understood that the standard was for canned sardine and sardine-type products. However, the objective was a comparative assessment using the *Guidelines for the Sensory Evaluation of Fish and Shellfish in Laboratories* (CXG 31-1999). The frozen, thawed, and cooked assessments should provide sufficient detail for this comparative assessment. Moreover, the idea of exclusion of canned sardines was supported by the other Member countries.
3. On the other hand, a Member country maintained its position to include sensory evaluation on canned fish with samples processed under the same conditions. Moreover, it raised concerns regarding the evaluation of candidate sardine species compared to existing ones without considering their preserved state. The current standard (CXS 94-1981) is based on assessing canned samples to detect defective units and evaluate sensory attributes such as smell, flavour, and flesh texture. Defective units are identified by organoleptic characteristics, such as excessively spongy or tough flesh, in the preserved state. Therefore, without preserved state comparisons, the quality and safety assessments of new species like *S. lemuru* are unreliable. It emphasizes that organoleptic evaluations must primarily involve comparisons in the preserved state, with fresh, frozen, or thawed state assessments being supplementary and insufficient for definitive conclusions.
4. The Member countries supported the position that sensory evaluations of sardines should include assessments of the canned state. This inclusion would ensure that the unique organoleptic characteristics contributed by the canning process were properly evaluated, aligning with the requirements of the current standard (CXS 94-1981).
5. The EWG Chair and Co-chair recommended that IPMA to identify a partner from a technological center or a commercial facility since they had extensive experience in the product and know how it behaves at different cooking temperatures. It was also recommended that the same partner prepared the preserves for all three laboratories, since small changes in the processing of the preserves could change the final product.
6. A Member country proposed establishing a partnership with a local company, for the canning of sardines, identifying Conservas de Peixe da Figueira SA (COFISA) as the industry partner to undertake this processing. This was agreed by other Member countries.
7. The EWG Chair and Co-chair accepted the offer to organize the canning process, ensuring uniform processing of products derived from various species. Additionally, there was a need to seek recommendations on the packing medium (e.g., in oil), as this meant changes to the proposal from participating laboratories. Furthermore, clarification was raised regarding who will conduct the RT-PCR analysis.
8. A Member country recommended the use of vegetable oil, provided that it conformed to the requirements of the Codex Standard (CXS 94-1981) listed under Sub-Section 3.2. Moreover, it was suggested that an RT-PCR test was no longer necessary to validate the species of *S. lemuru* since the requirements stated under Section II on the Procedure for the Inclusion of Additional Species in Codex Standards for Fish and Fishery Products, No. 3, paragraphs -a to -d had already been established in the Project Document. Furthermore, these recommendations were supported by a Member country.
9. Member countries recommended the use of vegetable oil and brine solution, as these minimally interfere with the product properties. A Member country also proposed retaining the RT-PCR in identifying *S. lemuru*.
10. Based on EWG members' inputs, a majority supported the inclusion of canned sardines. A proposal to simulate canning via increased cooking temperature as an alternative was discussed, acknowledging the distinct organoleptic profile of canned sardines was not replicated by simplified cooking. The final agreement entailed evaluating frozen samples via CXG 31-1999 for sensory assessment and including canned sardines evaluated with CXS 94-1981, packed in vegetable oil and brine solution. Additionally, RT-PCR would be performed to verify the sample's identity.
11. The posted agenda had 741 views in the forum.

**APPENDIX III****SUMMARY OF DISCUSSION ON THE****“TYPE OF SAMPLES FOR FROZEN, THAWED, AND COOKED CONDITIONS”**

1. The CCFFP35 and the EWG Chair and Co-chair finalized the reference species *Sardina pilchardus* (European Pilchard), *S. aurita* (Round Sardinella), and *S. maderensis* (Madeiran Sardinella) for assessment in comparison with *S. lemuru*. Canned sardines were set for sensory evaluation in a participating laboratory, while samples of the specified species were being assessed for frozen, thawed, and cooked conditions. Challenges in acquiring *S. maderensis* for assessment were due to time and budget limitations. The Philippine project lead proposed excluding *S. maderensis* from evaluation and sought the EWG's approval. The EWG's previous discussions highlighted the necessity of comparing canned sardines for the proposed inclusion of *S. lemuru* in the *Standard for Canned Sardines and Sardine-Type Products* (CXS 94-1981).
2. The proposal to advance with the analysis excluding *S. maderensis* was supported by Member countries.
3. A Member country expressed concern over the inadequate samples of *S. maderensis*, suggesting that measures should have been implemented earlier to secure adequate quantities of all three sardine species for the organoleptic evaluation process. Furthermore, it emphasized that Members of the EWG should have been notified in advance about the difficulties in obtaining *S. maderensis*. Consequently, it also proposed aligning with the resolutions of the Codex Committee on Fish and Fishery Products at its 35th Session (CCFFP35), which recommends substituting *S. gibbosa* in place of *S. maderensis* for the organoleptic evaluation if the latter is unavailable.
4. The Member countries reviewed both proposals, considering the options of either excluding *S. maderensis* from the analysis or replacing it with *S. gibbosa*.
5. The posted agenda had 236 views in the forum.

**APPENDIX IV****SUMMARY OF RESULTS AND DISCUSSIONS ON “LABORATORY FINDINGS”****Introduction**

1. The EWG Chair and Co-chair disseminated the final findings of the lead laboratory (Intertek ITALIA Spa) for review and feedback from other EWG Member countries on January 10, 2024.
2. The findings were structured into three distinct categories: sensory evaluation, molecular analysis, and crude fat determination.

**Sensory evaluation**

3. The canned sardines in brine and in vegetable oil can be considered free of defect attributes. The attributes of typical characteristics of odour and flavour of canned sardines in vegetable oil and brine can be considered in trend of the type of product. The sensory attributes of *S. pilchardus*, *S. aurita*, and *S. lemuru* can be associated in the same cluster of characterization about visual, smell, taste and consistency sensory perception. The consistency of *S. maderensis* can be considered different from *S. lemuru*, *S. aurita*, and *S. pilchardus*, which can be associated with the dimensions of the fish.
4. The frozen *S. lemuru* exhibited a combination of characteristics that share similarities with both *S. aurita* and *S. pilchardus*; however, it tended to lean more towards the latter species.
5. Among the various species, thawed, and raw *S. lemuru* was characterized by slightly higher levels and intensities of both fishy and rancid odours. This was accompanied by visible discolouration and conspicuous drip loss, which ultimately contributes to a less firm consistency of the meat in comparison to other species. Nonetheless, the different species did not exhibit significant discrepancies from one another in thawed-raw condition.
6. The thawed cooked *S. lemuru* exhibited a distinctive flavour profile that combined sweet and savoury notes with subtle undertones of staleness, mustiness, and metallic elements. The texture of the product was observed to have a moist consistency characteristic.
7. The sensory evaluation results presented received support from the Member countries.
8. However, one Member country noted significant sensory differences between the thawed and raw states, but these were not translated into a differential assessment of the final canned product. Additionally, the Member country aimed to ascertain whether significant differences existed among the values of frozen, thawed raw, and thawed cooked samples listed in Tables 9, 10, and 11 (Sensory Evaluation: Canned Sardines in Brine and in Vegetable Oil).
9. Referring to paragraph 8, the lead laboratory confirmed that the canning process standardizes the final product by minimizing variations typically present in raw states. Not all descriptors exhibited significant differences, e.g., fishy and rancid in thawed, raw, and descriptors like odour, rancid, salty, sweet, bitter, sour, old/mouldy, fishy, metallic/ferrous, and chewiness in thawed, cooked.
10. In addition to paragraph 8, a Member country raised concerns on the analysis of the report which indicated that the evaluation conducted by the three laboratories lacked complete harmonization: (1) variation in the number of assessors, (2) discrepancies in the number of samples tested, and (3) inconsistencies in the number of descriptors evaluated.
11. The questions presented in paragraph 10 were consulted with the lead laboratory, which confirmed that the sensory evaluation was conducted according to CXG 31-1999 guidelines by all laboratories, as detailed in the laboratory reports. While the number of assessors for visual analysis varied slightly due to the involvement of specialists, these variations were immaterial as no discrepancies were found in visual parameters. Differences between species were mainly noted in taste, smell, and texture. All laboratories analyzed the same number of samples, with *S. maderensis* only available in canned form due to limited catches, a decision deemed not to affect the report's conclusions. Variations in the number of descriptors, such as skin integrity and spine discoloration, were limited to visual parameters and did not impact the report's conclusions.
12. Likewise, a Member country made a query on the validation of the effectiveness of assessor training, as per the Section 4.1 of CXG 31-1999 guidelines. Since the report did not specify that this validation had been conducted. Additionally, the report mentioned that specialized technicians assessed specific criteria instead of the designated assessors.
13. The lead laboratory confirmed that all laboratories conducted assessor training in accordance with CXG 31-1999. Visual characteristics were assessed by specialized technicians with extensive experience in fish products, while designated assessors assessed all other parameters.

14. A Member country also raised an issue concerning the discrepancy in the firmness parameters between *S. lemuru* in the thawed raw state and the parameters of firmness and moistness for *S. lemuru* in the thawed cooked state, as highlighted in the report.

15. Referring to paragraph 14, the EWG Chair and Co-chair acknowledged discrepancies in the parameters of *S. lemuru* in its thawed raw state compared to the reference species. However, it is important to note that CXS 94-1981 primarily concentrates on canned sardine and sardine-type products.

16. A Member country expressed concerns about the adequacy and clarity of the sensory evaluation reports, indicating the necessity for additional information to facilitate comprehensive deliberation and discussion. Key areas for enhancement included: (1) detailing sample attributes such as quantity, size, weight, and the utilization of Certified Reference Materials (CRMs) for each descriptor, and (2) outlining the procedures employed, which encompassed sample description (e.g. preparation of frozen samples, transportation conditions, and thawing processes), the protocol and criteria utilized for assessment, and a delineation of data collection methodologies.

17. In response to paragraph 16, the data and results from the three laboratories conducting the sensory evaluation of canned sardines in brine and vegetable oil were included in the April 2024 report entitled "Report on Sensory Evaluation of Frozen *Sardinella lemuru* Rev2."

18. A Member country highlighted the differences in the average of fat content and organoleptic properties between species. The varying average of fat content among different species (*S. lemuru*: 7.2% and 4.8%, *S. pilchardus*: 8.3%, *S. aurita*: 1.1%, and *S. maderensis*: 0.7%) raised questions about why this disparity does not appear to significantly affect the sensory profile of the canned end products, given that a high fat content is a crucial factor for ensuring the quality of finished goods. Further investigation could be beneficial to explore the conclusion that the sensory profiles of the various canned species generally fall within the same cluster.

19. In consideration to paragraph 18, the three laboratories conducted the sensory evaluation in accordance with CXG 31-1999 guidelines, with fat content measured independently to ensure sensory results were unaffected by other analyses. The descriptors used did not account for fat content, although variations in texture for *S. maderensis* suggested that fat content may have influenced this parameter.

### **Molecular analysis**

20. Samples of *S. maderensis* and *S. pilchardus* were successfully identified using Next Generation Sequencing (NGS). However, for the other samples it was not possible to distinguish *S. longiceps* from *S. aurita* and from *S. lemuru* using both methods (i.e. Sanger and NGS). Stern *et al.* (2018) proposed the existence of only one species *S. aurita* after using two more markers. Thus, *S. aurita* was proposed as the sole valid species for the subgenus *Sardinella*, and to designate subspecies status to its two parapatric morphospecies. Therefore, *S. aurita* is proposed to be referred as the short head variant, synonymizing *S. brasiliensis* and *S. lemuru*, while *S. aurita longiceps* may indicate the long head variant, synonymizing *S. longiceps* and *S. neglecta*.

21. None of the Member countries have provided feedback on the molecular analysis results.

### **Crude fat determination**

22. During the initial round of commenting on the project document, a Member country recommended the inclusion of fat determination.

23. *S. lemuru* exhibited mean fat content values of  $7.2 \pm 1.6$  and  $4.8 \pm 0.4$  (g/100 g wet weight) for the 2 batches of samples, respectively. Meanwhile, mean values (g/100 g, wet weight) for *S. maderensis*, *S. aurita*, and *S. pilchardus* ranged from 0.7 to 8.3 (Annex X).

24. A Member country raised several concerns regarding the laboratory analyses, particularly highlighting issues with fat determination conducted solely by one laboratory. Secondly, there was an inconsistency in the number of samples across the three species, with the absence of *S. lemuru*. For fat determination in the frozen state, only two replicates were performed for *S. lemuru*. Furthermore, the determination of fat in *S. lemuru* was limited to the frozen state, without consideration for its preserved, thawed raw, or thawed cooked states.

25. The EWG Chair and Co-chair firmly maintained its stance that fat determination was not included in the ToR of the EWG (paras. 40 and 41, REP21/FFP) or its inclusion in the information required for the candidate species to be standardized (3. Information Required, Codex Procedural Manual, 27th ed. P.72-73) or in CXS 94-1981.

26. The posted agenda had 448 views in the forum.

**APPENDIX V****SUMMARY OF DISCUSSIONS IN THE EWG ON THE “SUSTAINABLE MANAGEMENT OF THE STOCKS OF *SARDINELLA LEMURU* IN THE NATURAL ENVIRONMENT”**

1. CCFP35 had preliminary discussions on the volume of stocks present in the natural environment and was informed about the Philippines National Sardines Management Plan that aims at ensuring the sustainable management of the stocks of *S. lemuru* in the natural environment (see REP21/FFP, para. 39 and CX/FFP 21/35/4 Add.2 Rev.1).
2. Members of the EWG were invited to provide information on management plans aiming at ensuring the sustainable management of the stocks of *S. lemuru* in the natural environment, including available information on *S. lemuru* population.
3. A Member country noted that IUCN assessment of *S. lemuru* as “near-threatened” and the need of research and stock assessments as well as the increase monitoring and regulation of fisheries catches to prevent further decline of its population. In this note, a Member country sought information how the management plan is applied and the scientific evaluation of *S. lemuru* stocks in the natural environment.
4. Furthermore, a Member country stated the importance of effective implementation of management plans in terms of species conservation.
5. A Member country commented regarding the need to provide updates on the Philippine National Sardine Management Plan, and economic and production data of *S. lemuru* for the last five years.
6. The FAO responded and noted that *S. lemuru* is more resilient to fishing pressure as they have been characterized by short life span, fast growth rate and high fecundity. Whilst, high fishing pressure were reported in the Philippines, FAO SOFIA assessment reported that the stock was considered maximally sustainably fished. Hence, *S. lemuru* stocks could not be considered of particular concern compared to other species listed in the *Standard for Canned Sardines and Sardine-Type Products* (CXS 94-1981). FAO also acknowledged the fisheries management plan adopted by the Philippines to ensure that stocks are exploited at their optimal biological potential and that the fishery can continue supporting livelihoods and contributing to the economy.
7. Guided by the important comments of the Member countries, the following points are the summary of the attached (Annex IX) “The Fishery of *Sardinella lemuru* in the Philippines: Status, Biomass and Sustainability”:

**Biomass estimate in the natural environment**

8. The estimated biomass for Bicol was 74,225,395.49 kg (74,225.39 tonnes), covering an area of 151 square nautical miles. In the Zamboanga Peninsula, the estimated biomass was 59,107,450.50 kg (59,107.45 tonnes), covering an area of 658 square nautical miles. Both fishing areas were based on hydroacoustic data and optimal interpolation.
9. These estimates highlight the critical importance of Bicol Region and the Zamboanga Peninsula as major habitats for *S. lemuru* given that there is a larger potential presence for this species even with the smaller coverage area in the shorter time for the hydroacoustic surveys.

**Status and sustainability**

10. By FMA, the largest proportion of *S. lemuru* was sourced from FMA 4 accounts for the 69% which is equivalent to 1,009,756 tonnes followed by the FMA 7 accounts for the 12%, equivalent to 171,967 tonnes of the total *S. lemuru* production for the last five years (2019-2023).
11. The management interventions to prevent further decline of *S. lemuru* stocks such as the closed fishing season in Zamboanga Peninsula has improved the volume of production in FMA 4 (Figure 3 of Annex IX). In addition, the value of *S. lemuru* production has also increased from 2019-2023 (Figure 4 of Annex IX).
12. Reference points identified by FMA 4 were: fishing mortality, length at first capture (Lc), percentage of matured individuals, spawning potential ratio (SPR), exploitation ratio catch per unit effort. On the other hand, RPs of FMA 7 include percentage of matured individuals, percentage of megaspawner, percentage within length optimum range, SPR, Lc, Current Fishing mortality over the fishing mortality at maximum sustainable yield (F/Fmsy), and Current biomass over the biomass at maximum sustainable yield (B/Bmsy) (Table 6 of Annex IX).
13. The HCR of FMA 4 were primarily based on the SPR such that at a given percentage of SPR, the number of fishing days in the designated fishing zone may be increased or decreased. For FMA 7, HCR depends on the status of stocks based on their target and limit RPs such as reducing capacity of fishing effort,

regulation of gears that catch juveniles, zonation, and closed fishing season. These HCRs have undergone review and evaluation of respective management bodies of each FMA (Table 7 of Annex IX).

**APPENDIX VI****LIST OF PARTICIPANTS**

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EUROPEAN UNION European Commission, Codex Contact Point	European Union
EUROPEAN UNION European Commission	Gaspar Avendano Perez
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FRANCE SGAE	Lucas PROUST
FRANCE Ministère de l'agriculture et de l'alimentation	Sylvie LARROUTIS
INDIA Food Safety Standard and Authority	Codex-India
INDONESIA Ministry of Fisheries and Marine Affairs	Lia Sugihartini
MEXICO COFEPRIS	Mariana Jiménez Lucas
MOROCCO ONSSA	Oleya El Hariri
MOROCCO ONSSA	Samah Tahri
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