



Criteria and analytical strategy for the safety assessment of medium-density fibreboard (MDF) for food contact

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Joint EDQM-AESAN Symposium on “Recent developments in food contact materials and articles” (CNA, Majadahonda 18-19 September 2024)

Context for the assessment

Medium-Density Fibreboard: multimaterial (wood + adhesive)

EU legislation:

Reg (EC) 1935/2004 Article 3. materials and articles shall be manufactured in compliance with Good Manufacturing Practices (Reg (EC) No. 2023/2006) so that, under normal or foreseeable conditions of use, they do not transfer their constituents to food in quantities which could:

- endanger human health, or
- bring about an unacceptable change in the composition of the food, or
- bring about a deterioration in the organoleptic characteristics thereof.

→ No specific measures for wood or adhesives

National legislation/others:

ADHESIVES: Spanish Royal Decree 847/2011

WOOD: France, Netherlands, Croatia (CoE Resolution on cork, no specific on wood)

Context for the assessment

Report of the Scientific Committee of the Spanish Agency for Food Safety and Nutrition (AESAN) on the risks associated with the use of medium-density fibreboard (MDF) as food contact material for fresh or refrigerated fruits and vegetables that are not peeled or cut

Reference number: AESAN-2021-006

Report approved by the Scientific Committee in its plenary session on 14 April 2021

Working group

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Abstract

Regulation (EC) No. 1935/2004 establishes the legal bases with regard to materials and articles intended to come into contact with food. This regulation provides for the adoption of specific measures or regulations for 17 groups of materials. Nevertheless, as of now, only plastics, regenerated cellulose, active and intelligent materials and ceramics are specifically subject to regulation.

Medium-density fibreboard (MDF) is a material that consists of wood, adhesive and water, for which there are no specific rules. Therefore, the Scientific Committee has been tasked with assessing a methodological proposal for verifying that MDF boards comply with article 3 of Regulation (EC) No. 1935/2004.

This article establishes that the materials and articles shall be manufactured in compliance with

Translated from the original published in the journal *Revista del Comité Científico de la AESAN*, 20, pp. 211-242

The National Association of Board Manufacturers (ANFTA):

- has elaborated a methodology to assess the suitability of MDF boards as a FCM, and
- requested the Scientific Committee of AESAN to assess its appropriateness to verify the compliance of MDF boards with Article 3 of Regulation (EC) No. 1935/2004.

Intended use: single-use packaging of fresh or refrigerated fruits or vegetables that have not been peeled or cut.



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Medium-Density Fibreboard (MDF)

Thickness
 ≤ 3 mm

Wood
84-88 %

Amino-
resins
6-7 %

Water
5-10 %

Processed material consisting of lignocellulosic fibres bonded together with water and an adhesive.



Wood fibres mixed with adhesive, dried with hot air and pressed ($T > 100$ °C) to convert the glue into a polymer, releasing water and the free formaldehyde that may have remained in the adhesive.



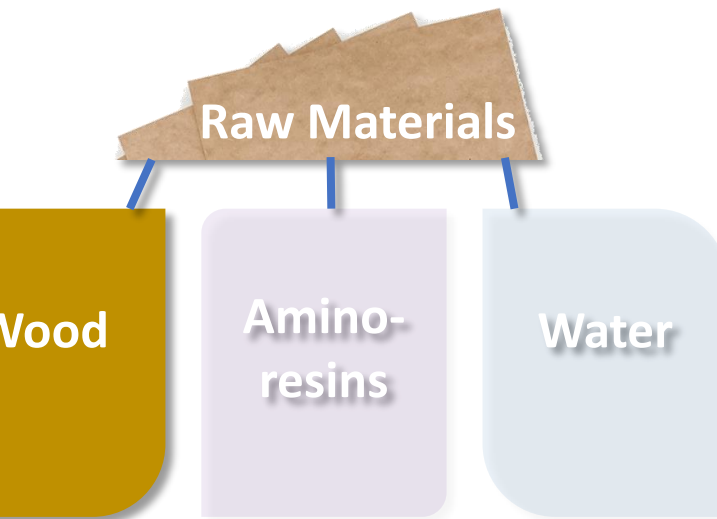
Environmental humidity affects the moisture content, dimensions and the resistance of MDF boards. Water immersion renders it unusable.

Assessment of the AESAN Scientific Committee: Raw materials

From logging, wooden off-cuts and other by-products of untreated wood from the manufacturing of plywood, or sawmill residue.

Sustainable sources
Species:

Non-coniferous species ($\leq 10\%$): *Eucalyptus globulus* and *Populus alba*



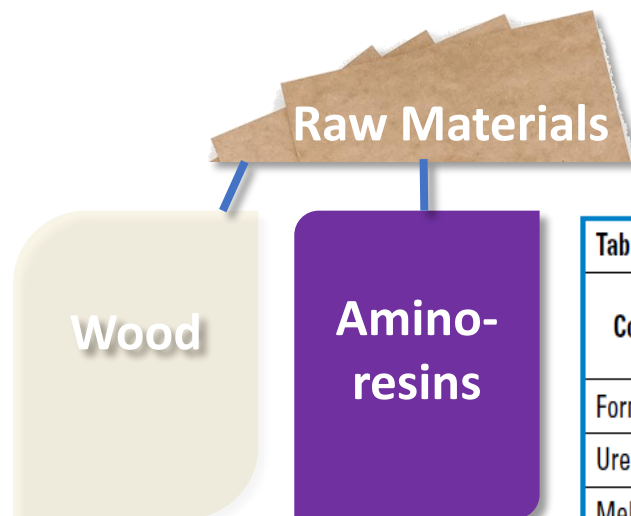
Coniferous species: *Pinus pinaster* (most frequently-used), *Pinus radiata*, *Pinus sylvestris* and *Pinus nigra*



Not to be used any of the 14 woods species listed in the scientific opinion of EFSA (2019)

Assessment of the AESAN Scientific Committee: Raw materials

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Non-coniferous species ($\leq 10\%$): *Eucalyptus globulus* and *Populus alba*

Table 1. Typical compositions of adhesives used in MDF boards

Compound	kg/ton adhesive			% of adhesive		
	A	B	C	A	B	C
Formaldehyde	260	250	230	26	25	23
Urea	530	510	510	53	51	51
Melamine	0	30	50	0	3	5
Water	210	210	210	21	21	21



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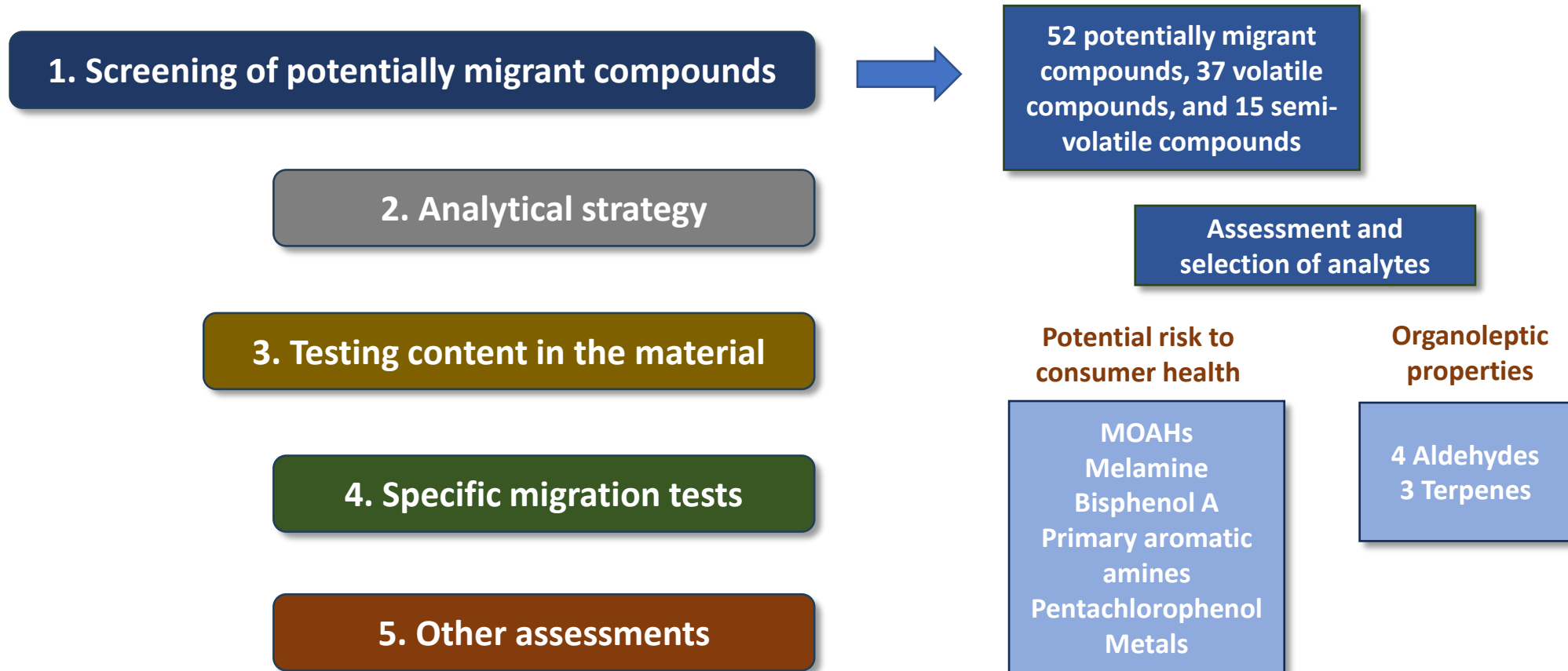


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Assessment of the AESAN Scientific Committee: Specifications of MDF boards



Medium-Density Fibreboard (MDF): Methodology



Medium-Density Fibreboard (MDF): Methodology

1. Screening of potentially migrant compounds

2. Analytical strategy

Determining the content of the analytes selected

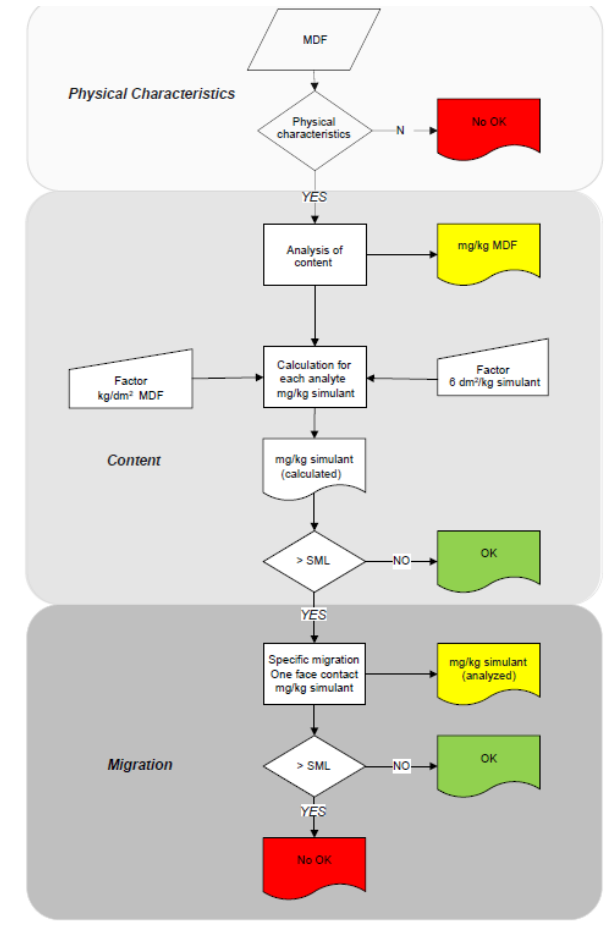
6 dm²/kg Estimation of the maximum possible migration

Specific migration limit not exceeded

Exceeded

Experimental migration testing not required

Migration testing in simulant E



A Proposed Methodology for Safety Evaluation from the Food Contact Point of View. In Food Packaging (pp. 347-368). CRC Press

Medium-Density Fibreboard (MDF): Methodology

1. Screening of potentially migrant compounds

2. Analytical strategy

3. Testing content in the material

- **Formaldehyde:** comes from the wood and the adhesive used to manufacture MDF boards.
- **Bisphenol A, Pentachlorophenol and PAAS:** contents below the quantification level.
- **Melamine:** aminoplast component used as glue, its content is very low.
- Determination of **specific migrations** for **Mn, MOAHs, aldehydes, terpenes, formaldehyde, melamine and Al.**



Table 6. Results of the aldehyde and terpene content in MDF boards

Parameter	Analytical technique	Content (mg/kg MDF)	Maximum migration calculation/10 (mg/kg food)	Limit (mg/kg food or simulant)
Pentanal	P&T GC-MS	<LD*-0.75	<LD-0.0096	Not established
Hexanal	P&T GC-MS	<LD*-0.75	<LD-0.0096	Not established
Octanal	P&T GC-MS	<LD*-0.75	<LD-0.0096	Not established
Nonanal	P&T GC-MS	<LD*-0.75	<LD-0.0096	Not established
α-Pinene	P&T GC-MS	<LD*-0.75	<LD-0.0096	Not established
α-Terpineol	P&T GC-MS	<LD*-0.75	<LD-0.0096	Not established
Caryophyllene	P&T GC-MS	<LD*-0.75	<LD-0.0096	Not established

Table 7. Results of the content analysis of different compounds in MDF boards

Parameter	Analytical technique	Content (mg/kg MDF)	Screening. Maximum migration calculation/10 (mg/kg food or simulant)	Limit (mg/kg food or simulant)	Reference
Formaldehyde	HPLC-DAD	57.1	<6.7	<6.7	
Melamine	HILIC-DAD	<6.7	<6.7	<6.7	
Bisphenol A	HPLC-FLD	<6.7	<6.7	<6.7	
Pentachlorophenol	HPLC MS/MS	<6.7	<6.7	<6.7	

Table 7. Results of the content analysis of different compounds in MDF boards

Parameter	Analytical technique	Content (mg/kg MDF)	Screening. Maximum migration calculation/10 (mg/kg food or simulant)	Limit (mg/kg food or simulant)	Reference
PAAs	HPLC MS/MS	<0.024	<0.0003	<0.01	
Al	ICP-MS	4.0-33.8	0.051-0.43	<1.0	
Ba	ICP-MS	0.39-1.8	0.0049-0.023	<1.0	
Co	ICP-MS	0.012-0.046	0.000153-0.00059	<0.05	
Cu	ICP-MS	0.04-1.7	0.00051-0.0217	<5.0	
Fe	ICP-MS	0.11-11.1	0.0014-0.1415	<48	Regulation (EU) No. 10/2011 (EU, 2011)
Li	ICP-MS	0.02-0.056	0.000255-0.00071	<0.6	
Mn	ICP-MS	7.9-71.1	0.10-0.907	<0.6	
Zn	ICP-MS	1.1-11.0	0.014-0.14	<5.0	
Pb	ICP-MS	0.009-0.077	0.00011-0.00098	<0.01	
Cd	ICP-MS	0.005-0.050	0.000063-0.00084	<0.002	
Ni	ICP-MS	0.029-0.20	0.00037-0.00255	<0.02	
Cr	ICP-MS	0.023-0.089	0.00029-0.0011	<0.01	
As	ICP-MS	0.031-0.074	0.0004-0.00094	<0.002	
Hg	ICP-MS	n.d.**-0.0004	n.d.-0.000005	<0.003	(Council of Europe, 2013)
V	ICP-MS	0.0004-0.021	0.000005-0.00027	<0.01	
MOAHs (C16-C35)	LC-GC-FID	<2.23***	<0.0255-0.293***	0.50/0.15****	(BMEL, 2020)

Medium-Density Fibreboard (MDF): Methodology

1. Screening of potentially migrant compounds

2. Analytical strategy

3. Testing content in the material

4. Specific migration tests

Selection of testing conditions

- 10 days at 20 °C .
- Relative humidity: 75 and 90 %.

Simulant selection

- Simulant E (Tenax[®]).
- Additional tests on strawberries.

Specific migration tests

- Aldehydes, Terpenes, Formaldehyde, Melamine, Al, Mn and MOAHs.



Medium-Density Fibreboard (MDF): Methodology

1. Screening of potentially migrant compounds

2. Analytical strategy

3. Testing content in the material

4. Specific migration tests

5. Other assessments

Organoleptic impact

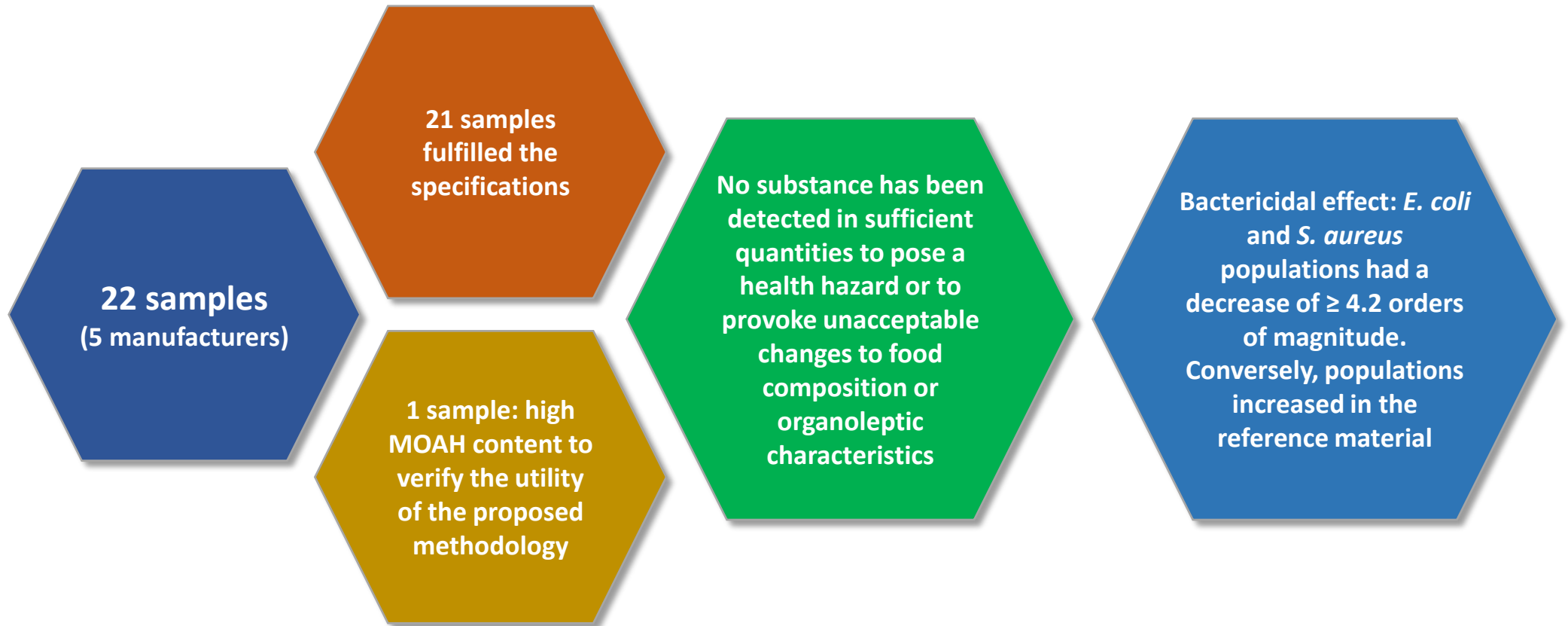
- Olfactory-gustatory sensations of strawberries due to packaging was assessed according to the standard UNE ISO 13302:2008.
- No statistically significant differences (ANOVA) were detected with regard to the control sample for accepted tastes, odours and aromas as well as for strange ones.

Antibacterial activity

- MDF sample surfaces: *E. Coli* and *S. aureus* below the limit of detection (1 CFU/cm²).



Medium-Density Fibreboard (MDF): Analysed samples



MDF use as FCM* : Conclusions of the AESAN's Scientific Committee

*(for fruits and vegetables not peeled or cut, single use packaging)

- **Wood:**
 - to mention the specific woods used in each case
 - the place of logging, and
 - any other data relevant for assessing the safety of the boards. It is worth establishing a series of specifications.
- **Adhesive:**
 - complete composition must be provided
 - in accordance with Royal Decree 847/2011.
 - ensured that the inclusion of formaldehyde in the finished product does not render it unsuitable for food contact use.
- **Water content:** Since the content may increase depending on the relative humidity of storage of the boards, tests should be conducted keeping in mind the representative conditions of use.

MDF use as FCM* : Conclusions of the AESAN's Scientific Committee

*(for fruits and vegetables not peeled or cut, single use packaging)

- **Proposed analytical strategy:** of identifying the possible migrant compounds and conducting specific migration tests
 - Correct and good starting point for assessing compliance with Art. 3 of Reg (EC) No. 1935/2004

Remarks /Recommendations:

- **Selection of substances** the screening phase for migration control should not be limited exclusively to substances with organoleptic impact and substances with legal or recommended restrictions. The risk assessment must consider all detected substances that may potentially migrate to the food in contact.
- Recommends drawing up a **sector-based Guide** with a detailed protocol to be followed in order to demonstrate that requirements are fulfilled in the process of manufacturing articles from food contact MDF boards.

Guide of the National Association of Board Manufacturers: Conclusions of the AESAN's Scientific Committee

- The **Guide** for the verification of the suitability of the MDF board intended for the manufacture of containers for fresh or refrigerated fruits and vegetables that are not peeled or cut **is acceptable, at the present time, for the intended purpose.**

Recommends:

- that the **types of wood** suitable for use be:
 - defined by their botanical names,
 - reflecting their origin and percentages of different woods used in each case.
 - any other species would require a prior study regarding its safety and conformity with Art. 3 of Reg. (EC) No. 1935/2004.
- Update** of the **Guide** regularly , according to the experience of its application, the progress in scientific knowledge, and changes in legislation and guidelines that may be established



https://www.aesan.gob.es/AECOSAN/docs/documentos/seguridad_alimentaria/valuacion_riesgos/informes_cc_ingles/GUIDE_MDF_BOARDS.pdf



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