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**Foodstuffs — Methods of analysis for  
the detection of genetically modified  
organisms and derived products —  
General requirements and definitions**

**AMENDMENT 1**

*Produits alimentaires — Méthodes d'analyse pour la détection  
des organismes génétiquement modifiés et des produits dérivés —  
Exigences générales et définitions*

AMENDEMENT 1



Reference number  
ISO 24276:2006/Amd.1:2013(E)

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## Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

Amendment 1 to ISO 24276:2006 was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 16, *Horizontal methods for molecular biomarker analysis*.

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# Foodstuffs — Methods of analysis for the detection of genetically modified organisms and derived products — General requirements and definitions

## AMENDMENT 1

### *Page v, Introduction*

Replace the existing text with the following.

The purpose of an analysis for the detection of genetically modified organisms and derived products is to identify and optionally quantify genetic elements or proteins common to genetically modified organisms (GMOs) and their derived products in a given matrix.

These steps are detailed in this International Standard and in the following documents:

ISO 21569, *Foodstuffs — Methods of analysis for the detection of genetically modified organisms and derived products — Qualitative nucleic acid based methods*

ISO 21570, *Foodstuffs — Methods of analysis for the detection of genetically modified organisms and derived products — Quantitative nucleic acid based methods*

ISO 21571, *Foodstuffs — Methods of analysis for the detection of genetically modified organisms and derived products — Nucleic acid extraction*

ISO 21572, *Foodstuffs — Methods for the detection of genetically modified organisms and derived products — Protein based methods*

Specific information pertaining to protein detection methods is found in ISO 21572.

### *Page 1, Scope*

Replace the existing first paragraph with the following.

This International Standard specifies how to use the standards for nucleic acid extraction (ISO 21571), qualitative nucleic acid analysis (ISO 21569), quantitative nucleic acid analysis (ISO 21570) and protein-based methods (ISO 21572), and explains their relationship in the analysis of genetically modified organisms in foodstuffs.

### *Page 1, 3.1*

Replace 3.1.2 to 3.1.26 with the following.

#### **3.1.2**

##### **laboratory sample**

sample received by the laboratory and intended for inspection or testing

NOTE Adapted from ISO 7002:1986,<sup>[9]</sup> A.19.

### 3.1.3

#### **test sample**

representative fraction of the laboratory sample to be ground

### 3.1.4

#### **test portion**

portion of the test sample as prepared for testing or analysis, the whole quantity being used for analyte extraction at one time

NOTE Adapted from ISO 6887-2:2003,[5] 3.2.

### 3.1.5

#### **specificity**

property of a method to respond exclusively to the characteristic or analyte under investigation

### 3.1.6

#### **sensitivity**

change in the response divided by the corresponding change in the concentration of a standard (calibration) curve

NOTE This is the slope of the analytical calibration curve.

### 3.1.7

#### **limit of detection**

##### **LOD**

minimum amount or concentration of the analyte in a test sample which can be detected reliably but not necessarily quantified, as demonstrated by a collaborative trial or other appropriate validation

NOTE See Reference [2] for collaborative trial and Reference [3] for validation.

### 3.1.8

#### **limit of quantification**

##### **LOQ**

lowest concentration or amount of the analyte in a test sample which can be quantitatively determined with an acceptable level of precision and accuracy, as demonstrated by a collaborative trial or other appropriate validation

NOTE See Reference [2] for collaborative trial and Reference [3] for validation.

### 3.1.9

#### **accuracy**

closeness of agreement between a test result and the accepted reference value

[ISO 5725-1:1994, 3.6]

### 3.1.10

#### **trueness**

closeness of agreement between the average value obtained from a large series of test results and an accepted reference value

NOTE 1 The measure of trueness is usually expressed in terms of bias. Trueness has been referred to as "accuracy of the mean".

NOTE 2 Adapted from ISO 5725-1:1994, 3.7.

### 3.1.11

#### **precision**

closeness of agreement between independent test results obtained under stipulated conditions

NOTE 1 Precision depends only on the distribution of random errors and does not relate to the true value or to the specified value.

NOTE 2 The measure of precision usually is expressed in terms of imprecision and computed as a standard deviation of the test results. Lower precision is reflected by a larger standard deviation.

NOTE 3 “Independent test results” means results obtained in a manner not influenced by any previous result on the same or similar test object. Quantitative measures of precision depend critically on the stipulated conditions. Repeatability and reproducibility conditions are particular sets of extreme conditions.

[ISO 5725-1:1994, 3.12]

**3.1.12  
repeatability**

precision under repeatability conditions

[ISO 5725-1:1994, 3.13]

**3.1.13  
reproducibility**

precision under reproducibility conditions

[ISO 5725-1:1994, 3.17]

**3.1.14  
repeatability conditions**

conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time

[ISO 5725-1:1994, 3.14]

**3.1.15  
reproducibility conditions**

conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment

[ISO 5725-1:1994, 3.18]

NOTE When different methods give test results that do not differ significantly, or when different methods are permitted by the design of the experiment (as in a proficiency study or a material certification study for the establishment of a consensus value of a reference material), the term “reproducibility” may be applied to the resulting parameters. The conditions should be explicitly stated.

**3.1.16  
repeatability standard deviation**

standard deviation of test results obtained under repeatability conditions

[ISO 5725-1:1994, 3.15]

NOTE Repeatability standard deviation is a measure of the dispersion of the distribution of test results under repeatability conditions. Similarly “repeatability variance” and “repeatability coefficient of variation” could be defined and used as measures of the dispersion of test results under repeatability conditions.

**3.1.17  
reproducibility standard deviation**

standard deviation of test results obtained under reproducibility conditions

[ISO 5725-1:1994, 3.19]

NOTE Reproducibility standard deviation is a measure of the dispersion of the distribution of test results under reproducibility conditions. Similarly “reproducibility variance” and “reproducibility coefficient of variation” could be defined and used as measures of the dispersion of test results under reproducibility conditions.

### 3.1.18

#### **repeatability limit**

value less than or equal to which the absolute difference between two test results obtained under repeatability conditions may be expected to be with a probability of 95 %

NOTE 1 The symbol used is  $r$ .

[ISO 5725-1:1994, 3.16]

NOTE 2 When examining two single test results obtained under repeatability conditions, the comparison should be made with the repeatability limit  $r = 2,8s_r$ , where  $s_r$  is the standard deviation of repeatability.

### 3.1.19

#### **reproducibility limit**

value less than or equal to which the absolute difference between two test results obtained under reproducibility conditions may be expected to be with a probability of 95 %

NOTE 1 The symbol used is  $R$ .

[ISO 5725-1:1994, 3.20]

NOTE 2 When examining two single test results obtained under reproducibility conditions, the comparison should be made with the reproducibility limit  $R = 2,8s_R$ , where  $s_R$  is the standard deviation of reproducibility.

### 3.1.20

#### **collaborative trial interlaboratory study**

study in which several laboratories detect and/or determine an analyte in one or more "identical" portions of homogeneous, stable materials under documented conditions

NOTE Guidelines for performing collaborative trials are elaborated in ISO 5725-2<sup>[8]</sup> and the ISO/AOAC/IUPAC harmonized protocol (Reference [6]).

### 3.1.21

#### **fitness for purpose applicability**

scope of application of the method which identifies the matrix, analyte or species being measured, its concentration range and the type of study/monitoring effort for which the procedure, as judged from its performance characteristics, is suited

NOTE It also describes the known limitations of the method (Reference [3]).

### 3.1.22

#### **practicability**

ease of operations, in terms of sample throughput and costs, to achieve the required performance criteria and thereby meet the specified purpose

### 3.1.23

#### **applicability range range of quantification/linearity/dynamic range**

quantity interval within which the analytical procedure has been demonstrated by a collaborative trial or other appropriate validation to have a suitable level of precision and accuracy

NOTE See Reference [2] for collaborative trial and Reference [3] for validation.

### 3.1.24

#### **measurement uncertainty**

parameter associated with the result of a measurement, which characterizes the dispersion of the values that could reasonably be attributed to the analyte

**3.1.25  
screening method**

method that rapidly and reliably eliminates (screens) a large number of negative (or positive) test samples and restricts the number of test samples requiring the application of a rigorous method

NOTE 1 See Reference [4].

NOTE 2 In this International Standard, a screening method detects gene products (such as proteins) or genetic elements (such as promoters, terminators, or other genetic elements of interest) common to several GMOs.

**3.1.26  
construct-specific method**

method that targets a combination of inserted DNA sequences that are only found in GMO-derived material

**3.1.27  
event-specific method**

method that detects a specific sequence that is only present in a specific transformation event

NOTE This is commonly targeted at the integration-border region.

*Page 8, Figure 1*

Replace Figure 1 with the following.

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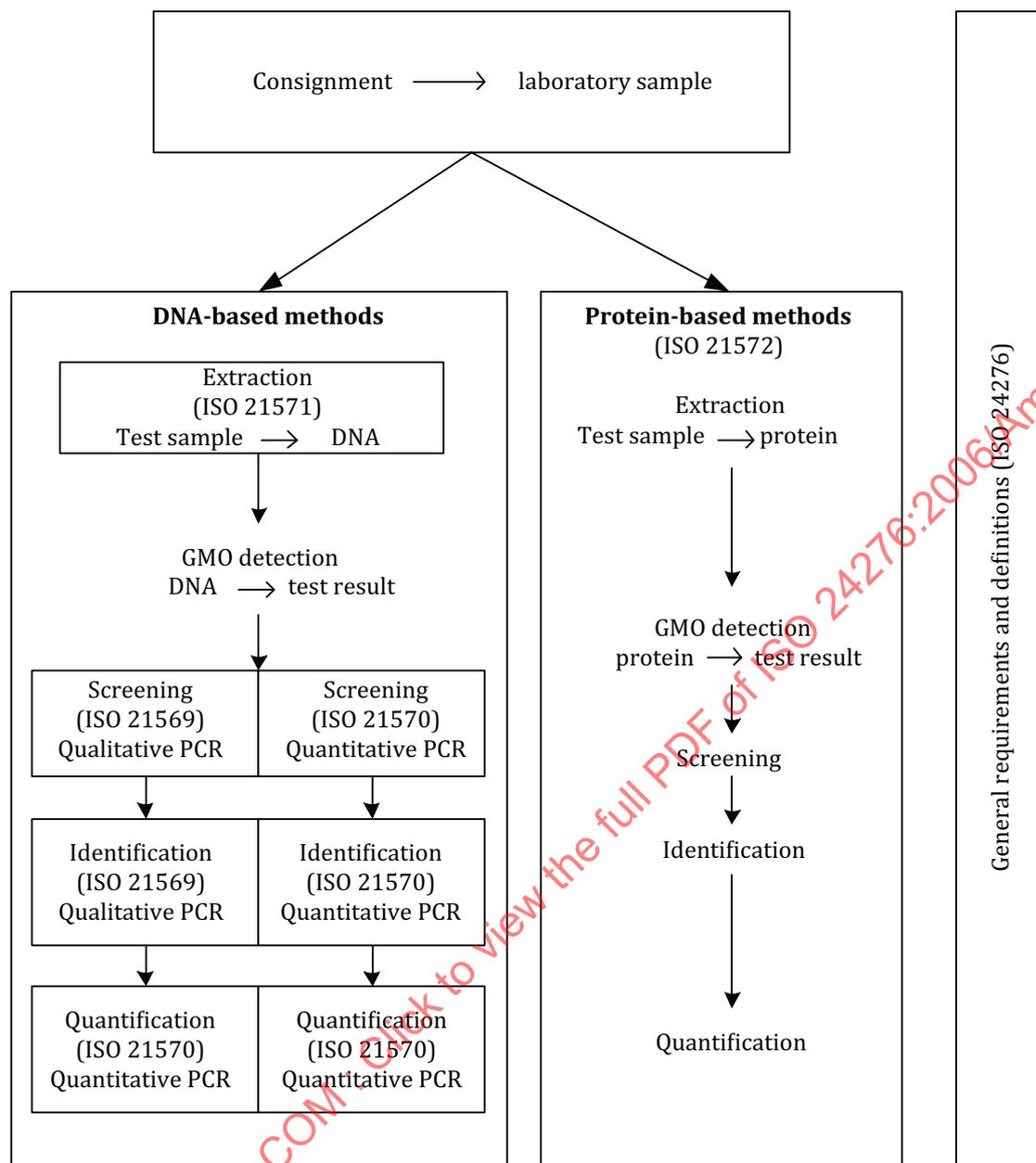


Figure 1 — Flow diagram of interrelationships of International Standards on GMO detection methods

Page 9, 4.3

Replace 4.3.2 and 4.3.3 with the following.

#### 4.3.2 Limit of detection (LOD)

The LOD values for each analytical method as specified in the annexes of ISO 21569, ISO 21570 and ISO 21572 are based on data from collaborative trial validation and/or claims from the method developer, and are included for information purposes only. The LOD values reported from collaborative trial data generally refer to the lowest level of analyte that was observed to have a false negative rate of less than or equal to 5 %.

#### 4.3.3 Limit of quantification (LOQ)

The LOQ values for each analytical method as specified in the annexes of ISO 21570 and ISO 21572 are based on data from collaborative trial validation and/or claims from the method developer, and are included for information purposes only.

Page 10, 5.1 and 5.2

Replace the existing text with the following.

### 5.1 General

The procedure includes the following steps:

- preparation of the test sample (*optional* with the customer agreement: if the test sample is not the whole laboratory sample, homogenize the laboratory sample and obtain test samples in accordance with the relevant International Standards);
- grinding of the test sample;
- preparation of test portions;
- extraction of the analyte;
- testing, interpretation, and reporting of the results.

Procedure-specific instructions are found within the main text and the individual annexes of ISO 21569, ISO 21570, ISO 21571 and ISO 21572.

### 5.2 Use of controls

The controls shall be used according to Table 1. Table 1 is applicable to DNA-based methods only. Controls applicable to protein-based methods are described in ISO 21572.

**Table 1 — Flow diagram showing intersection of successive steps and inclusion of controls**

Control step	Environment control <sup>b</sup>	Extraction blank control <sup>c</sup>	Positive extraction control <sup>d</sup>	Positive DNA target control <sup>e</sup>	Negative DNA target control <sup>f</sup>	Amplification reagent control <sup>g</sup>	PCR inhibition control <sup>h</sup>
Homogenization	Mandatory	—	—	—	—	—	—
Nucleic acid extraction	↓ <sup>a</sup>	One per series	Mandatory at regular intervals	—	—	—	—
Assessment of nucleic acid quality	↓	↓	↓	—	—	—	—
Nucleic acid amplification	↓	↓	↓	Mandatory	Recommended	Mandatory	Recommended, but mandatory in certain cases <sup>i</sup>
Assessment of results of nucleic acid amplification	↓	↓	↓	↓	↓	↓	↓
Interpretation	—	↓	↓	↓	↓	↓	↓
Test report	—	↓	↓	↓	↓	↓	↓

<sup>a</sup> The arrows indicate that this control should be applied in the subsequent analytical steps.

<sup>b</sup> The use of environment controls helps the laboratory to identify sources of contamination at an early stage and can even be used to identify in which work area the contamination is present. This can be demonstrated in various ways, e.g. if negative samples included in the series of homogenized samples showed negative results, starting at the first step of the process (e.g. grinding step if relevant)

<sup>c</sup> At least one extraction blank control shall be included each time DNA is extracted from one or more samples. The tube shall always be the last in each series. It may be appropriate to put one extraction blank on, for example, a rack of eight tubes or a microplate of 96 wells for automated extraction.

<sup>d</sup> A positive extraction control should be included regularly, and always when a new batch of extraction reagents is used. This control reveals if something is wrong with the reagents or the performance of the extraction protocol.

<sup>e</sup> The positive DNA target control demonstrates the ability of the nucleic acid amplification procedure to detect the nucleic acid representative of the GMO or target taxon. This condition can also be fulfilled by an appropriate positive extraction control.

<sup>f</sup> The negative DNA target control demonstrates the ability of the nucleic acid amplification procedure to avoid false positive amplification in the absence of the nucleic acid representative of the GMO or target taxon.

<sup>g</sup> The amplification reagent control demonstrates the absence of contaminating nucleic acid in the PCR reagent batches used. The amplification reagent control can be omitted when the extraction blank control is used.

<sup>h</sup> The PCR inhibition control may be used to demonstrate the absence of soluble inhibitors. This may also be demonstrated by serial dilutions of the template nucleic acid. However, some type of assessment of the effect of soluble inhibitors on the results of the analysis of the sample shall be made.

<sup>i</sup> A PCR-inhibition control is mandatory, if all PCR-tests on the sample are negative and for matrices where the yield of amplifiable DNA is not known.

Page 12, 5.3.4

Replace the existing text with the following.

The laboratory should use properly maintained equipment suitable for the methods employed. In addition to standard laboratory equipment, additional apparatus is described in the annexes of the specific standards.

Apparatus and equipment shall be maintained according to guidelines outlined in ISO/IEC 17025;<sup>[10]</sup> manufacturers' instructions should be taken into consideration.

Page 14, Table 2

Replace the existing Table 2 with the following.