Protocol for an assessment of quality of processed organic food products (online)

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Based on: Protocol for an assessment of quality of processed organic food products

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Version 2

Introduction

If food processors are planning to produce processed organic food or to invest in new processing technologies, it is important to evaluate whether new or existing processing technologies comply with organic principles. However, the present regulatory framework does not provide extensive guidance on how to evaluate organic food processing. Therefore, experts gathered within the ProOrg project developed an Assessment Framework (AF), with a main objective of providing guidance on how to assess quality of processed organic food products. The AF provides guidance on how to evaluate processing technologies for production of organic food.

The protocol for an assessment of quality of organic food products affected by product processing guides users through the three main phases of the assessment process, which is in more detail described in the AF (see figure 1). Possible aims of assessment are depicted in figure 2. This document is not substituting the AF but complementing it by giving a step-by-step-approach that strictly follows the steps explained in the AF. Therefore, the protocol should be used alongside the AF. In the end of this process you should be able to compare and decide which processing method is more in line with organic principles and/or to what extent the quality of the processed product differs from raw materials for an organic food product of your choice.

Before using the assessment protocol, you can read the Assessment framework document and an example of an assessment of apple juice production (file Case example apple juice) to get more information on theory and details of each assessment step in this protocol.

To perform the assessment described in this protocol, use Excel file Assessment table.

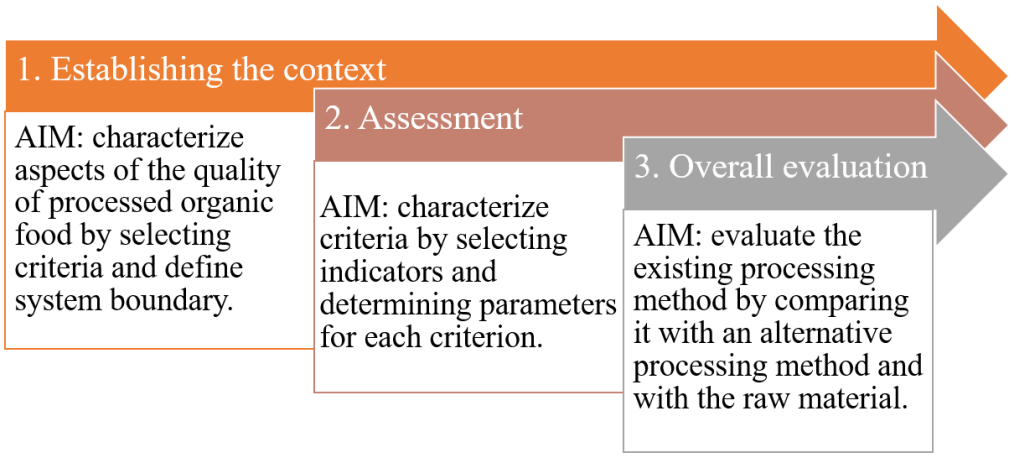

Figure 1. Three main phases of the assessment of processing methods for production of organic food products.

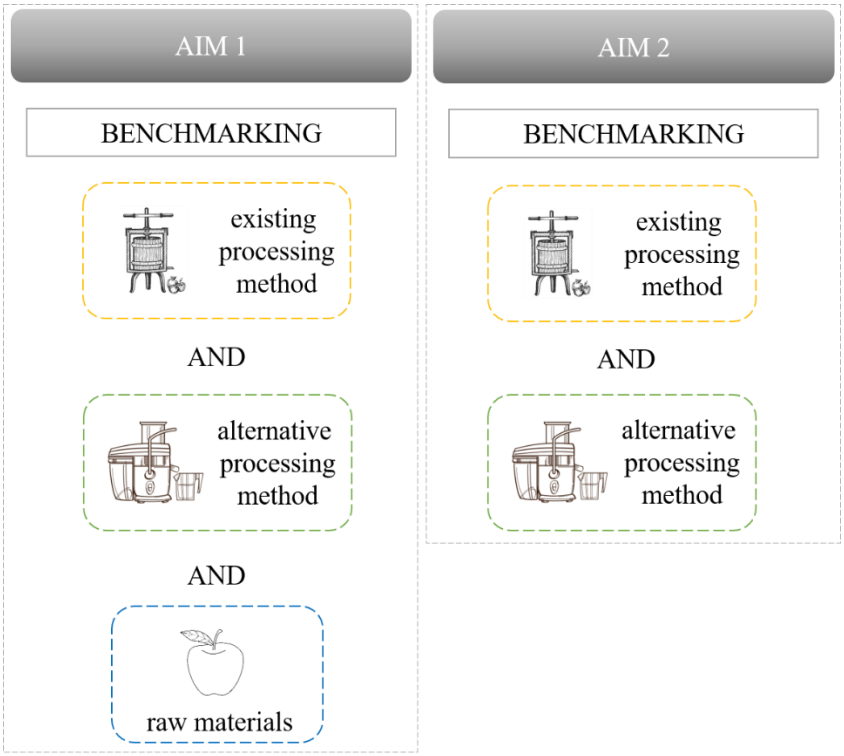

Figure 2. The assessment process of organic product quality within this framework can have multiple aims. While the main aim (aim 1) is to benchmark an existing processing method, an alternative processing method and raw materials, another aim is benchmarking an existing and alternative processing method (aim 2).

Step 1: ESTABLISHING THE CONTEXT

The aim of this step is to characterize different aspects of organic food quality (i.e., sustainability, nutritional quality, and sensory quality) that can be affected by product processing and to identify reference raw materials for the naturalness check. Moreover, the aim is to define a system boundary. Follow the steps below to establish the context.

Substep 1.1.

a) Choose a processed organic product for which you will perform an assessment and choose your main objective of the assessment (Aim 1 or Aim 2 - see figure 2 as an example).
b) List processing steps of an existing processing method for this product (see figure 3 as an example).
c) List inputs and outputs for each processing step (see figure 3 as an example).
d) Choose an alternative processing method for the product you selected. List processing steps for production of this product.
e) List inputs and outputs for each processing step (see figure 3 as an example).

If you selected to perform AIM 1, also do the following:

f) Identify reference raw materials for the chosen processed product.
(*USE: Excel sheet 1. Processing steps, cell F9*)

Substep 1.2.

a) For each of the three aspects (nutritional quality, sensory quality, sustainability) determine what criteria are affected/are changing during processing of the product and in what processing steps these criteria are affected (you need to select criteria that are applicable for both the existing and alternative processing methods since you will later have to compare them).

   You can use table in Annex 1 of the AF to select criteria (or and Excel sheet with examples), but you should also think of criteria that are not in Annex 1 and add them if they are relevant for your case.
   (*USE: Excel sheet 2. List criteria,indicator,param, Column C*)
b) How and how much are selected criteria affected during processing (for both existing and alternative processing method)? Explain shortly in written format (qualitatively).
   (*USE: Excel sheet 2. List criteria,indicator,param, Column F*)

If you selected to perform AIM 1, also do the following:

c) Select which nutritional and sensory criteria and why are suitable to compare quality of raw materials and processed products. Select those criteria from the ones that you determined for processing methods in substep 1.2.a.
Environmental sustainability criteria will not be used for comparison with raw materials.
(*USE: Excel sheet 3. Naturalness check criteria, Column C to add criteria, Column F to answer why*)

Substep 1.3.

a) Draw a system boundary around those processing steps and criteria that you will consider in your assessment. You can decide what is important to consider based on the outcome of the previous substep (e.g., what criteria are you suspecting are being substantially changed when two different processing methods are compared; what criteria are you suspecting are being substantially changed when a processed product is compared with the raw material).
(*USE: Excel Sheet 1. Processing steps, Read Instructions for use in Cell B42*
or draw the boundary in the sketch on Whiteboard – depending on what you used to list processing step)

b) For any processing steps and criteria that are outside of the boundary, explain in written form why they are not being included in the assessment.
(*USE: Excel Sheet 1. Processing steps, Cell B50*)

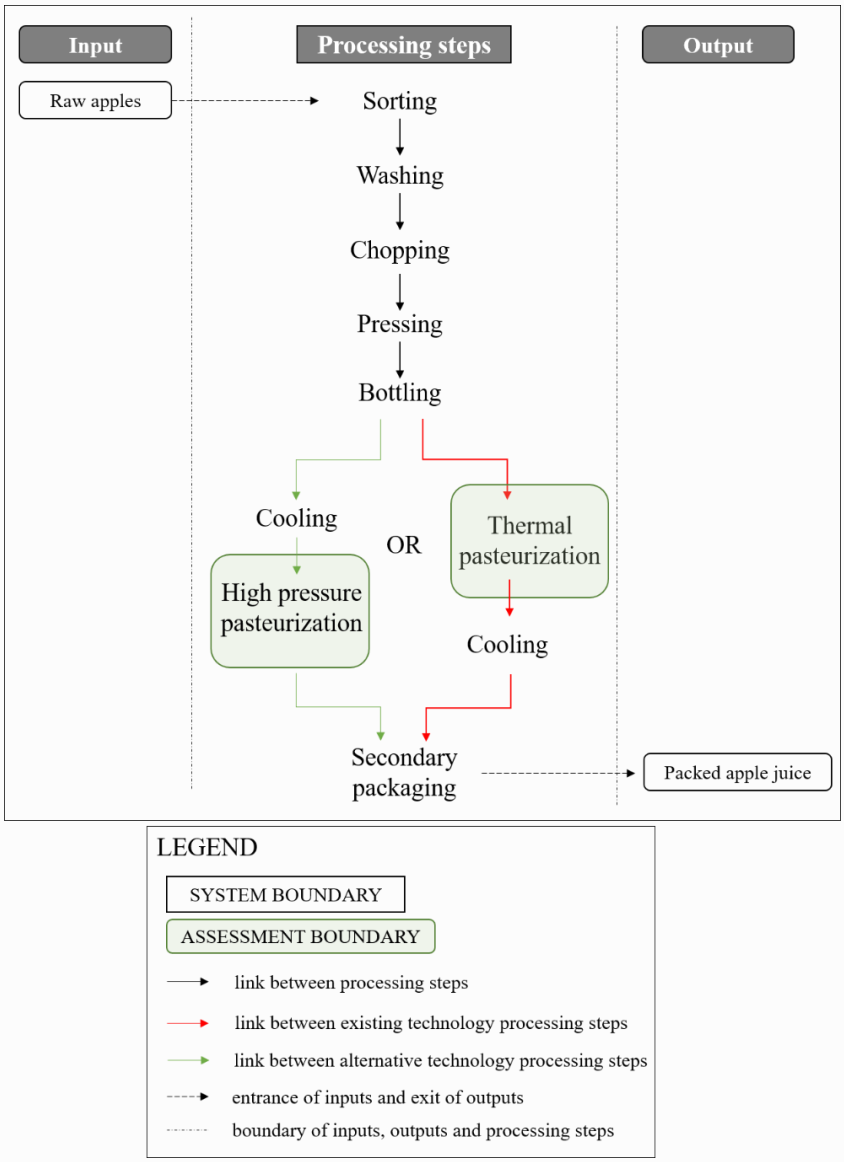

Figure 3. An example of processing steps, inputs, outputs and a system boundary for processing of apple juice with two different heating methods. Based on the example from Annex 2 of the Assessment Framework.

Some definitions:

FOOD PROCESSING – All processes *after* "primary production" like cleaning, preserving, mixing, transforming packaging, labelling of foods targeted for human consumption.

> EU Regulation 178/2002 Art 3 17 defines 'primary production' as "the production, rearing or growing of primary products including harvesting, milking and farmed animal production prior to slaughter. It also includes hunting and fishing and the harvesting of wild products;".

A CRITERION describes organic food quality according to process- and product-related aspects. Criteria can be characterized and measured by indicators.

Step 2: ASSESSMENT

The aim of this step is to characterize the relevant criteria identified in step 1 by identifying suitable indicators and parameters for each criterion (see figure 4 as an example). Follow the steps below to assess processing methods for an organic food product.

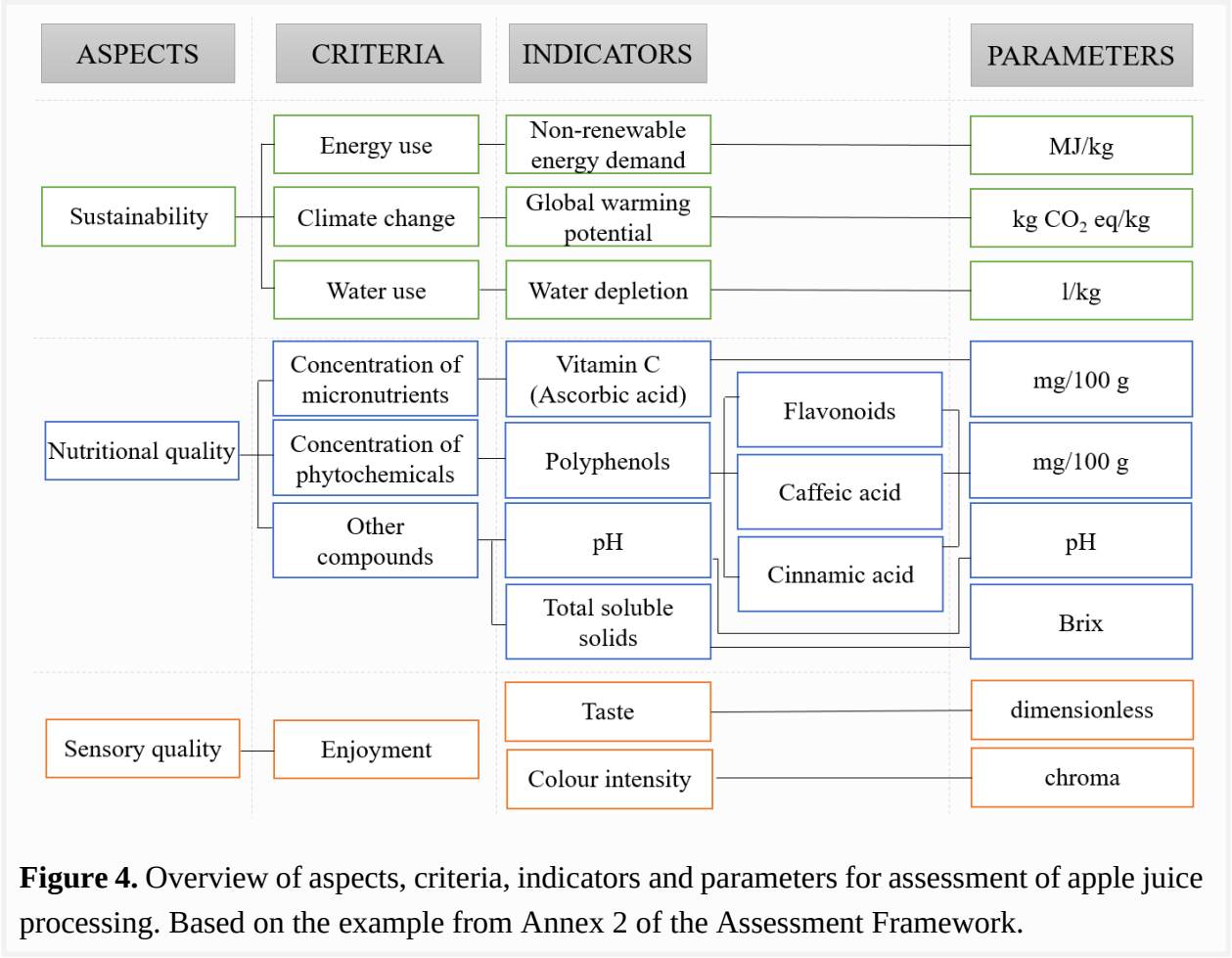

Figure 4. Overview of aspects, criteria, indicators and parameters for assessment of apple juice processing. Based on the example from Annex 2 of the Assessment Framework.

Some definitions:
An INDICATOR is a measurement used as a representation of an associated (but non-measured or non-measurable) factor or quantity. Indicators are further determined through parameters and methods. An example for an indicator describing the criterion enjoyment is sensory attributes.
A PARAMETER is a measurable variable whose value determines the characteristics of an indicator. E.g., sensory profiles and its analyses can be the parameter and method to describe the indicator sensory attributes, which describes the criteria enjoyment.

Substep 2.1.

a) Once again, check if you listed all important criteria and if all important criteria fall within the system boundary. For all criteria that are important for the assessment, choose indicators that sufficiently describe those criteria for both the existing and alternative production methods.

   One criterion may have multiple indicators.

   Sheet 9. Annex_List of criteria contains some indicators for some criteria, which may be a guideline, but it is not a complete list for all products and processing methods. You can add criteria that are not on that list and that are relevant in your case

   (*USE: Excel sheet 2. List criteria,indicator,param*)

Substep 2.1.b

b) Choose parameters that can be used to quantify indicators identified in substep 2.1.

   Sheet 9. Annex_List of criteria contains parameters for some indicators which may be a guideline, but it is not a complete list for all products and processing methods.

   (*USE: Excel sheet 2. List criteria,indicator,param*)

Substep 2.2.

If you selected to perform AIM 1, also do the following

a) To compare raw materials with a processed product, you will use criteria and indicators that you listed for nutritional and sensory aspects. List those indicators in a separate sheet.

   (*USE: Excel sheet 3. Naturalness check criteria*)

Substep 2.3.

a) Determine numeric values of parameters for all identified indicators separately for an existing and an alternative processing method. These will be your absolute indicator scores needed to perform step 3 of the assessment (in workshop 2). List data sources where you obtained those numeric values.

   If a measurable parameter does not exist, use a semi-quantitative approach – give a score to a qualitative value of a parameter to obtain a quantitative scale (e.g., sustainability aspect can include an indicator “job satisfaction of the manufacturers”. For example, Likert scale can be used to quantify it: from extremely satisfied (value 10) to extremely unsatisfied (value 0).

   (*USE: Excel sheet 4. Data collection, Columns F, G and I*)

b) Additionally, determine numeric values of parameters for all identified indicators for raw material(s). These will be your absolute indicator scores needed to perform step 3 of the assessment in workshop 2. List data sources where you obtained those numeric values.

   If a measurable parameter does not exist, use a semi-quantitative approach by scoring qualitative values of a parameter to obtain a quantitative scale (e.g., sustainability aspect can include an indicator "job satisfaction of the manufacturers". For example, Likert scale can be used to quantify it: from extremely satisfied (value 10) to extremely unsatisfied (value 0).

   (*USE: Excel sheet 4. Data collection, Column H*)

Step 3: <u>OVERALL EVALUATION</u>

The aim of this phase is to evaluate the criteria selected in step 1 and to:

- decide which processing method for the chosen organic product is more in line with organic food quality (AIMS 1 and 2 in Figure 2).

Some definitions:
To BENCHMARK is to evaluate something by comparing it with a standard.
A BENCHMARK is a standard or point of reference against which things may be compared.

Substep 3.1.

Substep 3.1 instructs how to transform numeric values of indicators that were determined in substep 2.3 (absolute indicator score) to criterion scores, which are needed to perform the overall evaluation (see figure 5).

Figure 5. Path from absolute values of indicators to the criteria score need to perform the overall evaluation

a) Normalized indicator score

The indicators that you selected and quantified represent an absolute indicator score (see Column C & E in table 1). They were probably measured on different scales and have different parameters. Therefore, you need to standardize values of indicators to normalized dimensionless indicator scores between 0-100 (i.e., columns D & F in table 1).

1. Firstly, you need to choose a standard or a benchmark.
    a. To decide which processing method is more in line with organic food quality, a benchmark will be absolute scores of indicators of an existing technology (column C, table 1). This means that all normalized scores for indicators of the existing technology will be 100 (column D, table 1).
    b. To benchmark processing method(s) and raw material(s), a benchmark will be absolute scores of indicators of raw material

(column 3, table 2). This means that all normalized scores for indicators of the raw material will be 100 (column 4, table 2).

2. Secondly, you need to calculate normalized scores for indicators of an alternative technology for comparison with the existing technology (column F, table 1) and/or raw material (column 6, table 2).

Equation 1. Calculation of normalized score of alternative technology in comparison with the existing technology

$$Normalized\ score\ of\ alternative\ technology\ = \\ = \frac{Normalized\ score\ of\ existing\ technology * Absolute\ score\ of\ alternative\ technology}{Absolute\ score\ of\ existing\ technology}$$

$$Column\ F = \frac{Column\ D * Column\ E}{Column\ C}$$

Equation 2. Calculation of normalized score of alternative technology in comparison with the raw material

$$Normalized\ score\ of\ raw\ material = \\ = \frac{Normalized\ score\ of\ existing\ technology * Absolute\ score\ of\ alternative\ technology}{Absolute\ score\ of\ existing\ technolog}$$

$$Column\ 6 = \frac{Column\ 4 * Column\ 5}{Column\ 3}$$

Table 1. Example of standardizing values of indicators pH and total soluble solids of the criterion "other nutritional compounds" (based on the example in Annex 2 of the Assessment framework) for existing and alternative technology.

Column A	Column B	Column C	Column D	Column E	Column F
		Existing technology		Alternative technology	
Criterion	Indicator	Absolute score	Normalized score	Absolute score	Normalized score
Other nutritional compounds	pH	3.8	100	3.4	89
	Total soluble solids	12.9 Brix	100	13 Brix	102

Table 2. Example of standardizing values of indicators pH and total soluble solids of the criterion "other nutritional compounds" (based on the example in Annex 2 of the Assessment framework) for raw material and alternative technology.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
		Raw material		Alternative technology	
Criterion	Indicator	Absolute score	Normalized score	Absolute score	Normalized score
Other nutritional compounds	pH	4.0	100	3.4	85
	Total soluble solids	13 Brix	100	13 Brix	100

b) Indicator rating scale

For practical reasons, transfer the normalized scores of alternative technology indicators (from Column F, Table 1 and from Column 6, Table 2) into a rating scale of, e.g., -2 (much worse) to 2 (much better) with 0 representing the benchmark (i.e., score 100). Use table 3 as a guideline. See Column G in Table 4 and Column 7 in Table 5 for an example of a solution.

Table 3. Conditions for transferring normalized scores of indicators of an alternative technology (from Column F, Table 1 and Column 6, Table 2) into a rating scale

Rating scale		Normalized score of the alternative technology*	Normalized score of the alternative technology**
-2	much worse	<50	>150
-1	worse	50-99	101-150
0	the same	100	100
1	better	101-150	50-99
2	much better	>150	<50

*use this when a lower score indicates a worse performance (e.g., for some sensory quality indicators, such as taste)

**use this when a lower score indicates a better performance (e.g., for some sustainability indicators, such as non-renewable energy demand)

Table 4. Example of transferring normalized scores of indicators of an alternative technology into a rating scale to decide which processing method is more in line with organic food quality (based on the example in Annex 2 of the Assessment framework)

Column A	Column B	Column C	Column D	Column E	Column F	Column G
		Existing technology		Alternative technology		
Criterion	Indicator	Absolute score	Normalized score	Absolute score	Normalized score	Rating scale
Other nutritional compounds	pH	3.8	100	3.4	89	-1
	Total soluble solids	12.9 Brix	100	13 Brix	102	1

Table 5. Example of transferring normalized scores of indicators of an alternative technology into a rating scale to benchmark the alternative processing method and raw material (based on the example in Annex 2 of the Assessment framework)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
		Raw material		Alternative technology		
Criterion	Indicator	Absolute score	Normalized score	Absolute score	Normalized score	Rating scale
Other nutritional compounds	pH	4	100	3.4	85	-1
	Total soluble solids	13 Brix	100	13 Brix	100	0

c) Criterion score

If all your criteria only have one indicator, your indicator rating scale is equal to the criterion score. In that case, you can skip this step and move to the substep 3.2.

However, the criterion "other nutritional compounds" from the example has two indicators and to continue the evaluation we need to calculate a criterion score. Therefore, one more calculation step is necessary to get a score for the criterion "other nutritional compounds":

$$\begin{aligned} &criterion\ score \\ &= (weighing\ factor\ of\ indicator\ 1 \\ &* \ rating\ scale\ of\ indicator\ 1) \\ &+ (weighing\ factor\ of\ indicator\ 2 \\ &* \ rating\ scale\ of\ indicator\ 2) \\ &+ (weighing\ factor\ of\ indicator\ n \\ &* rating\ scale\ of\ indicator\ n) \end{aligned}$$

To perform the above calculation, first determine the weighing factors for indicators 1 and 2. A weighting factor is a weight that you give to indicators within one criterion to assign them lighter, or heavier, importance in a group. If expressed as a percentage, sum of all weighing factors within one criterion should be equal to 100%.

EXAMPLE: For the simplicity of the illustrative example in tables 6 and 7, each indicator (pH and total soluble solids) was weighted with 50%, which means they both have the same importance. Therefore, values of both weighing factors 1 & 2 are 0.5. The calculation goes:

$$"Other\ nutritional\ compounds"\ criterion\ score\ (in\ table\ 6) = (0.5 * (-1)) + (0.5 * 1) = -0.5 + 0.5 = 0$$

$$"Other\ nutritional\ compounds"\ criterion\ score\ (in\ table\ 7) = (0.5 * (-1)) + (0.5 * 0) = -0.5 + 0 = -0.5$$

Table 6. Example table with a criterion score in column H to decide which processing method is more in line with organic food quality (based on the example in Annex 2 of the Assessment framework).

Column A	Column B	Column C	Column D	Column E	Column F	Column G	Column H
		Existing technology		Alternative technology			
Criterion	Indicator	Absolute score	Normalized score	Absolute score	Normalized score	Rating scale	Criterion score
Other nutritional compounds	pH	3.8	100	3.4	89	-1	0
	Total soluble solids	12.9 Brix	100	13 Brix	102	1	

Table 7. Example table with a criterion score in column 8 to benchmark the alternative processing method and raw material (based on the example in Annex 2 of the Assessment framework)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
		Raw material		Alternative technology			
Criterion	Indicator	Absolute score	Normalized score	Absolute score	Normalized score	Rating scale	Criterion score
Other nutritional compounds	pH	4	100	3.4	85	-1	-0.5
	Total soluble solids	13 Brix	100	13 Brix	100	0	

Substep 3.2.

a) Within each aspect, there is usually more than one criterion. As different criteria may not contribute to the same extent to the aspect score, you need to determine weighing factors of criteria to determine the aspect score. A weighting factor is a weight that you give to criteria to assign them lighter or heavier importance in a group. If expressed as a percentage, sum of all weighing factors within one aspect should be equal to 100%.

$$aspect\ score = (weighing\ factor\ of\ criterion\ 1 * criterion\ score\ of\ criterion\ 1) + (weighing\ factor\ of\ criterion\ 2 * criterion\ score\ of\ criterion\ 2) + (weighing\ factor\ of\ criterion\ n * criterion\ score\ of\ criterion\ n)$$

EXAMPLE: For the simplicity of our illustrative example in tables 8 and 9, each criterion was weighted with 33.3%, which means they both have the same importance. Therefore, values of weighing factors 1, 2 and 3 are 0.333. The calculation goes:

$$"Nutritional\ quality"\ aspect\ score\ (in\ table\ 8) = (0.333 * 2) + (0.333 * 2) + (0.333 * 0) = 1.332$$

$$"Nutritional\ quality"\ aspect\ score\ (in\ table\ 9) = (0.333 * (-1)) + (0.333 * (-2)) + (0.333 * (-0.5)) = -1.166$$

Table 8. Example table with an aspect score in column J to decide on which processing method is more in line with organic food quality (based on the example in Annex 2 of the Assessment framework).

Column I	Column A	Column H	Column J
		Alternative technology	
Aspect	Criterion	Criterion score	Aspect score
Nutritional quality	Concentration of micronutrients	2	1.332
	Concentration of phytochemicals	2	
	Other nutritional compounds	0	

Table 9. Example table with an aspect score in column 10 to benchmark the alternative processing method and raw material (based on the example in Annex 2 of the Assessment framework).

Column 9	Column 1	Column 8	Column 10
		Alternative technology	
Aspect	Criterion	Criterion score	Aspect score
Nutritional quality	Concentration of micronutrients	-1	-1.166
	Concentration of phytochemicals	-2	
	Other nutritional compounds	-0.5	

Substep 3.3.

a) As different aspects may not contribute to the same extent to the overall score, you need to determine weighing factors of aspects to determine the aspect score. A weighting factor is a weight that you give to aspects to assign them a lighter, or heavier, importance in a group. If expressed as a percentage, sum of all weighing factors within one criterion should be equal to 100%.

$$overall\ score = (weighing\ factor\ of\ aspect\ 1 * aspect\ score\ of\ aspect\ 1) + (weighing\ factor\ of\ aspect\ 2 * aspect\ score\ of\ aspect\ 2) + (weighing\ factor\ of\ aspect\ 3 * aspect\ score\ of\ aspect\ 3)$$

EXAMPLE: For the simplicity of our illustrative example in table 10, each aspect was weighted with 33.3%, which means they both have the same importance. Therefore, values of weighing factors 1, 2 and 3 are 0.333. The calculation goes:

$$overall\ score\ (table\ 10) = (0.333 * 1.322) + (0.333 * 1.000) + (0.333 * 1.667) = 1.328$$

In table 11, each aspect was weighted with 50% (since sustainability aspect is not considered in this case), which means they both have the same importance. Therefore, values of weighing factors 1 and 2 are 0.5. The calculation goes:

$$overall\ score\ (table\ 11) = (0.5 * (-1.166)) + (0.5 * 0) = -0.583$$

Table 10. Example table with the overall score in column 11 to decide which processing method is more in line with organic food quality (based on the example in Annex 2 of the Assessment framework).

Column I	Column J	Column K
	Alternative technology	
Aspect	Aspect score	Overall score
Nutritional quality	1.322	1.328
Sensory quality	1.000	
Sustainability	1.667	

Table 11. Example table with the overall score in column K to benchmark the alternative processing method and raw material (based on the example in Annex 2 of the Assessment framework).

Column 9	Column 10	Column 11
	Alternative technology	
Aspect	Aspect score	Overall score
Nutritional quality	-1.166	-0.583
Sensory quality	0	

Substep 3.4

a) Finally, the overall score for alternative technology needs to be compared to the overall score of the existing technology to evaluate which processing technology is more in line with organic principles. Moreover, a comparison needs to be made between the overall score of raw materials, an existing and alternative processing technology to see which one has a better score for naturalness.

EXAMPLE:

To decide which processing method is more in line with organic food quality, existing technology was a benchmark. That means the overall score for existing technology is 1. When compared to the overall score of 1.328 for the alternative technology, we can conclude that quality of an organic product produced with the alternative technology is better than quality of a product produced with the existing technology.

To benchmark an alternative processing method and raw material, the raw material was a benchmark. That means the overall score for the raw material is 1. When compared to the overall score of -0.583 for the alternative technology, we can conclude that quality of an organic product produced with the alternative technology is worse than quality of the raw material.