BREWUP

Calculate Nutritional Values

Toolkit

LAST UPDATE March 2018

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ABOUT THIS TOOLKIT

BACKGROUND

This toolkit has been developed jointly by The Brewers of Europe and the European Brewery Convention (EBC).

It is aimed at helping brewers to determine the nutritional values of their beers in order to:

- Share the energy value only; or
- The full set of nutritional values.

The toolkit has been designed to draw brewers' attention to available methods that would help them to calculate the nutritional values of their beer. It contains references to existing (and publicly available) methods and also advice on how they are able to deduce or calculate the data based on data available.

RESPONSIBILITIES

Neither The Brewers of Europe nor the European Brewery Convention (EBC) can be held responsible for any use of this Toolkit by third-parties. Brewers shall be held responsible for any information and data they share with consumers.

AIM OF THE TOOLKIT

Providing the nutrition declaration (either the energy only – i.e. calories/joules – or the full nutrition declaration, i.e. energy, fat, saturates, carbohydrates, sugars[1], proteins and salt) remains a voluntary decision for alcoholic beverages of more than 1.2% abv. However, there are some good reasons to provide this information to consumers. Europe's brewers have made the commitment, in 2015, to progressively share this information with consumers.

This Toolkit aims at helping brewers who wish to provide this information to consumers to obtain the nutritional values. To facilitate brewers' life, two paths have been designed to guide them through this Toolkit:

- Brewers would like to provide the information on the basis of the information that is currently available to them without overcrowding their workload? They should then refer to the Decision-Tree #1 on page 6.
- Brewers already know what information they want to provide, they are willing to make some efforts to get the data they want to share with consumers? They should then refer to Decision-Tree #2 on page 7.

Once the nutrition declaration has been obtained, there are specific rules to respect for sharing this information. They are all detailed in a Guidance developed by The Brewers of Europe and available in the Link section of this Toolkit.

[1] Sugars means all monosaccharides and disaccharides present in food, but excludes polyols (alcohols containing more than two hydroxyl groups)

LEGAL BACKGROUND

WHAT NEEDS TO BE DECLARED

The Regulation 1169/2011 provides for regulatory elements that need to be shared with consumers either on a mandatory basis or on the basis of voluntary declaration (in which case, the rules laid down in the Regulation have to be followed). This applies to the nutrition declaration (covered in articles 30 to 35 of the Regulation).

The below table summarizes the rule applying to alcoholic beverages, also covering beer .

Type of Product	Information to be provided (mandatory or voluntary)	Date of entry into force
≤ 1.2% abv	On a mandatory basis, per 100ml : • Energy value ; • Fat ; • Of which saturated fats ; • Carbohydrates ; • Of which sugars ; • Proteins ; • Salt.	As from 13 December 2016

>1.2% abv	On a voluntary basis, per 100ml :
	• Either Option 1 :
	  ○ Energy value only ;
	• Or Option 2 (also referred to as the « Big 7 »:
	  ○ Energy value ;
	  ○ Fat ;
	  ○ Of which saturated fats ;
	  ○ Carbohydrates ;
	  ○ Of which sugars ;
	  ○ Proteins ;
	  ○ Salt.
		Already entered into force

AUTHORISED METHODS OF OBTAINING NUTRITIONAL VALUES

Article 31-4 of the Food Information to Consumers Regulation lists three different methods to obtain the nutritional values of beer :

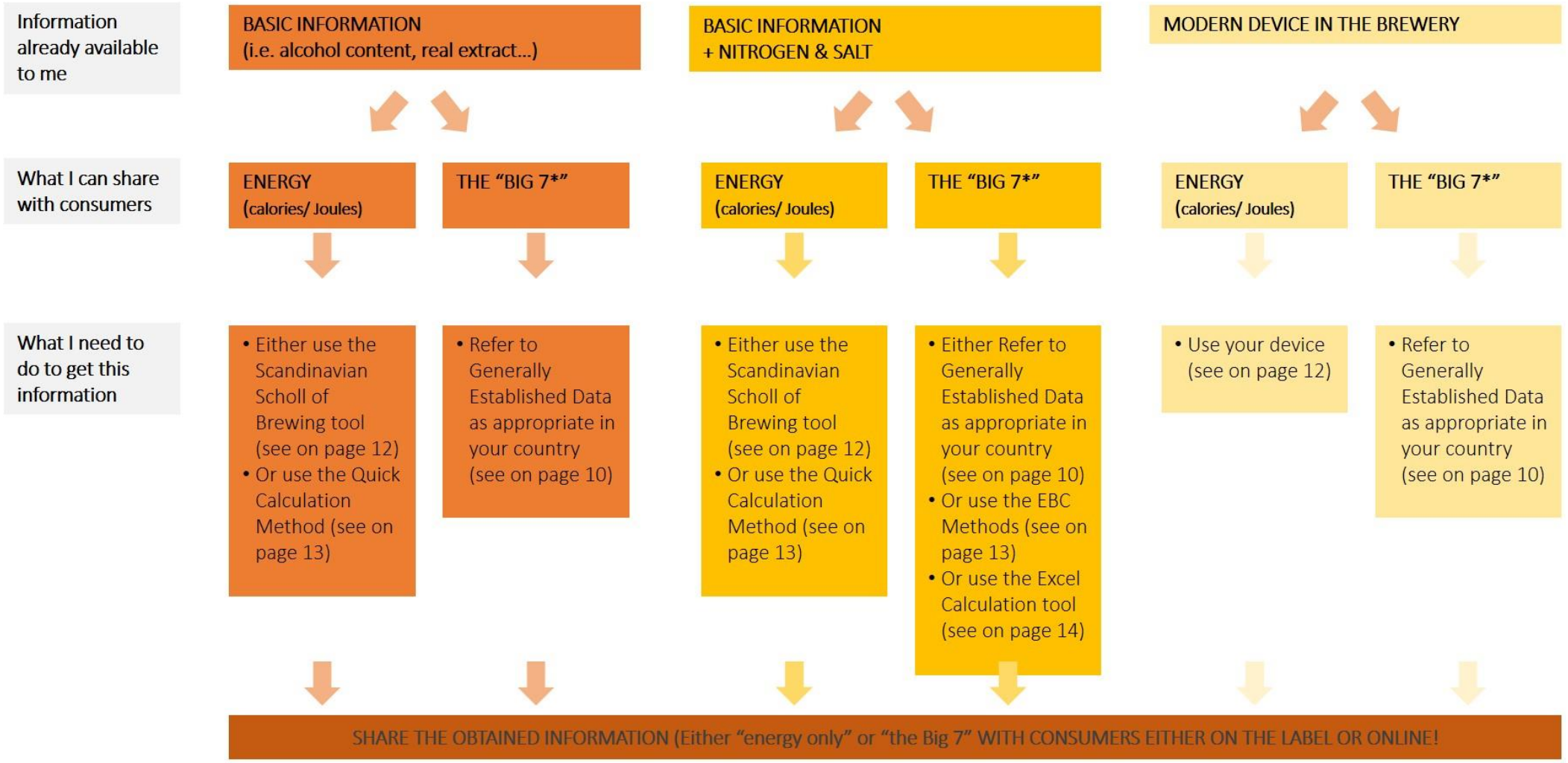
- Manufacturer's analysis of the food ; or
- Calculation from the known or actual average values of the ingredients used ; or
- Calculation from generally established or accepted data.

CONVERSION FACTORS

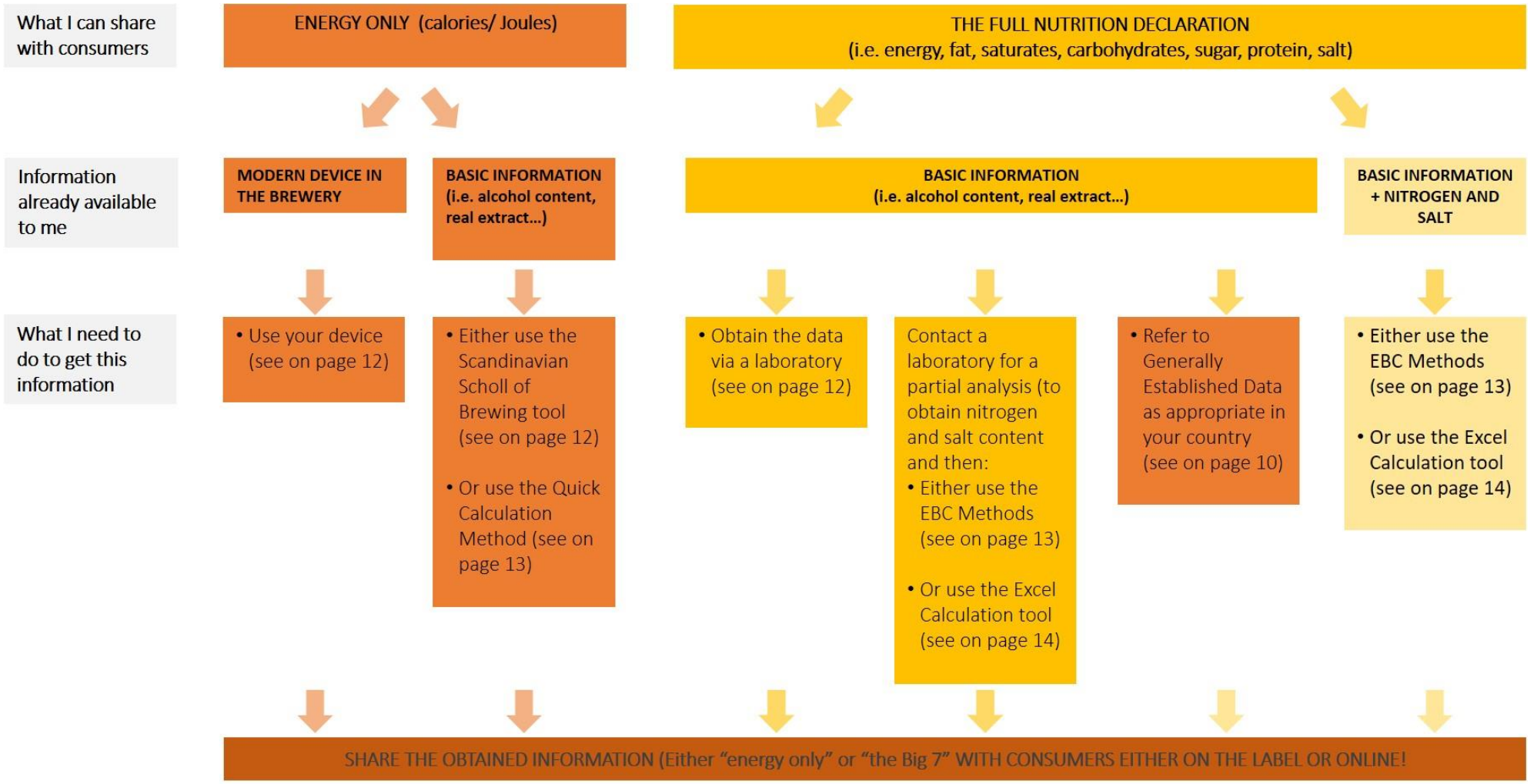
The energy (calories and joules) of a food is a sum of contributions from the different elements that compose the food (carbohydrates, fat, proteins, alcohol...). Therefore, the Regulation has established conversion factors (Annex XIV) to transform the amount of those elements from g per 100ml to calories. The following conversion factors apply to beer and help to calculate the total amount of calories:

Element	kcal (kilocalories) per gram	kJ (kiloJoules) per gram
Carbohydrates	4	17
Proteins	4	17
Alcohol (ethanol)	7	29

DECISION-TREE # 1 – PROVIDING THE NUTRITION INFORMATION ON THE BASIS OF INFORMATION BREWERS HAVE IN HAND



DECISION-TREE# 2 – PROVIDING SPECIFIC INFORMATION AND FINDING THE BEST WAY TO OBTAIN THIS INFORMATION



CALCULATING THE NUTRITIONAL VALUES

The methods presented in this Toolkit are all acceptable based on the current level of scientific understanding. The Brewers of Europe and EBC, should they recommend a method amongst the range of methods presented in this Toolkit, would recommend using the laboratory analysis as this allows for the most accurate results.

A. LABORATORY ANALYSIS METHOD

The Brewers of Europe and EBC recommend gathering the nutritional values of beer via a laboratory analysis as this allows for accurate results. The laboratory normally bears legal responsibilities for the data it provided.

1. BACKGROUND

Laboratory analysis allows for a brewer to obtain:

- Either the energy value only (in kcal and in kJ);
- Or the full nutrition information.

The laboratory will process to an analysis of the different component of beer that enter into the calculation of the calories (alcohol content, carbohydrates, proteins and possibly fat if any) and will then, on that basis, calculate the energy values of the beer.

2. CHOICE OF THE LABORATORY

In some member states, nutrition declaration must be based on analyses performed by accredited laboratories or on accredited analysis methods. It is important that brewers make sure that the laboratory they contact is capable (and if necessary, accredited) to perform the nutritional analysis of beer.

The Brewers of Europe and EBC recommend that brewers and/or trade associations check with their national authorities whether an accreditation for laboratories and/or for the analysis methods is needed. The Brewers of Europe and EBC will also assist brewers in providing information about accredited laboratories offering said analytical services to all brewers.

3. CONSISTENCY OF RESULTS THROUGHOUT BATCHES

Inter-batch consistency needs to be ascertained over time. Unless a brewing recipe is changed in terms of strength (original gravity and alcohol), there is little reason to assume that the nutritional values have changed, However, it is good quality assurance practice to keep track of drifting data which can indicate other, process-related issues in the brewery (also see point

4. Other benefits of laboratory analysis.). This is why The Brewers of Europe and EBC recommend performing regular analysis to ensure there is no significant variation over time.

4. OTHER BENEFITS OF LABORATORY ANALYSIS

Performing a laboratory analysis offers benefits for brewers, among these being:

- The data will be accurate and the responsibility for the data will be borne by the laboratory that would have performed the analysis;
- A "package" of different data can be obtained at the same time as the required nutritional data:
    - Information/data related to the quality of the product;
    - Information/data related to the safety of the product;
    - Information /data related to the process
- A "package" of different analysis can lead to an economy of scale (and a decrease of the relative price of each individual analysis).

Choosing to perform a nutrition analysis or a nutrition analysis combined with other analysis remains a decision to be taken by brewers on an individual basis.

B. CALCULATION FROM THE KNOWN OR ACTUAL AVERAGE VALUES

The legislation allows calculating the data on the basis of known or actual average values of the ingredients or of some product components. Three means are available to brewers that elaborate on that possibility:

- The EBC Analytica Methods;
- A Quick Calculation Methods);
- An Excel Calculation Tool.

EBC developed Analytica Method 9.45. to facilitate the derivation of nutritional values using algorithms with a reduced need for laboratory analysis. Other methods also exist (some of them are publicly available) to calculate the energy value (calories and kJ) on the basis of data brewers should have at their disposal.

The Quick Calculation Method is a simplified method derived from the EBC Analytica Method 9.45. and which requires less data.

An Excel Calculation Tool was recently developed by EBC and The Brewers of Europe, tested for some beers (to check the accuracy, consistency and validity of the method) and is presented here to facilitate the calculation of the nutritional values. The Excel Calculation Tool does require some laboratory analysis (nitrogen and salt) in order to deliver data for the "Big 7". A method of calculation that would require no laboratory analysis does not exist at the moment and will be unlikely to be developed in the future since protein values can only be derived via laboratory analyses. It needs to be pointed out that the shortcut is an abbreviated way of arriving at results which are fit for use but do not have the statistical ruggedness required by standard analytical methods.

C. GENERALLY ESTABLISHED AND ACCEPTED DATA

Some national authorities tolerate food business operators to indicate the average values of a given product based on data that are available in recognised food and nutrition databases. This means that, if such database exists in your country (or in another country) and that there is a reference for a beer similar to yours (e.g. Pilsner beer of 5% if you produce a Pilsner beer of approximately 5% ABV or strong beer if you produce a beer of approximately 8.5% ABV), you might be allowed to use the corresponding nutritional values references in that database on your label/website to inform consumers about the nutritional values of your product (even if the data do not exactly correspond to that of your product should it undergo a laboratory analysis).

Please note that such an approach varies:

- From one member state to another member state;
- Depending on whether a trusted database exists and/or is recognised as such by the national authority in charge of the implementation of Regulation 1169/2011;
- Whether a reference exists for your product in such a database.

Therefore, The Brewers of Europe and EBC recommend you checking with your national authorities what their approach is on that specific way (i.e. using data from a food and nutrition database) of sharing the nutritional values with consumers. The following table lists existing food composition databases by country (as made available to The Brewers of Europe).

Country	Link to the database	Comments
BE	https://www.nubel.be/	
CZ	http://www.nutridatabaze.cz/en/search-food-data/food-name/?action=result	
DK	http://frida.fooddata.dk/?lang=en	
EE	http://tka.nutridata.ee/tka/index.action?request_locale=en	
FI	https://fineli.fi/fineli/en/index?	
FR	https://pro.anses.fr/TableCIQUAL/index.htm	
EL	http://www.hhf-greece.gr/tables/Home.aspx?l=en	No occurrence for beer, though
IE	http://www.ucc.ie/archive/ifcdb/	Although it does not seem to work
IT	http://nut.entecra.it/646/tabelle_di_composizione_degli_alimenti.html	

LV	http://www.partikasdb.lv/
NL	http://www.rivm.nl/en/Topics/D/Dutch_Food_Composition_Database/Access_NEVO_data/NEVO_online
NO	http://www.matvaretabellen.no/
PL	http://www.izz.waw.pl/en/food-omposition-ata-ase
PT	http://www.insa.pt/sites/INSA/Portugues/AreasCientificas/AlimentNutricao/AplicacoesOnline/TabelaAlimentos/Paginas/TabelaAlimentos.aspx
SK	http://www.pbd-online.sk/
ES	http://www.bedca.net/bdpub/index.php
SW	http://www7.slv.se/SokNaringsinnehall/Home/ToggleLanguage
CH	German version: http://www.naehrwertdaten.ch/request?xml=MessageData&xml=MetaData&xsl=Start&lan=de&pageKey=Start Italian version: http://www.valorinutritivi.ch/request?xml=MessageData&xml=MetaData&xsl=Start&lan=it&pageKey=Start French version: http://www.valeursnutritives.ch/request?xml=MessageData&xml=MetaData&xsl=Start&lan=fr&pageKey=Start
UK	https://www.gov.uk/government/publications/composition-of-foods-integrated-dataset-cofid

THE DIFFERENT METHODS

This section present each available method on an individual basis to make sure brewers can get familiar with each of them.

A. LABORATORY ANALYSIS – ENERGY VALUE

The energy value (kcal and kJ per 100ml) may be obtained from a laboratory analysis. The laboratory will measure the amount of carbohydrates, proteins, fat (if any) and alcohol and calculate the energy value of the product.

B. LABORATORY ANALYSIS – THE « BIG 7 »

The fat, saturates, carbohydrates, sugar, protein and salt can be measured by a laboratory analysis. On the basis of the data obtained, the laboratory will be able to calculate the energy values of the beer (in kcal and kJ) and therefore equip the brewers with the full nutrition declaration.

C. MODERN DEVICE AVAILABLE IN THE BREWERY – ENERGY VALUE

Most instruments and measuring devices available in breweries nowadays also calculate the amount of calories in a beer (a calculation of standard beer parameters). For example, the following devices are suitable for calculating the calories for breweries of different sizes:

- >35,000HL – http://crmdocs.anton-paar.com/crm/crmdocdownload.nsf/0/CBD08021720C1EF0C1257EF9005263AE/$file/XDLIP017EN-A_screen.pdf
- ≤35,000HL – ALEX 500 from Anton Paar (http://crmdocs.anton-paar.com/crm/crmdocdownload.nsf/0/159D9687164E68B2C1257F470078D400/$file/C97IP001EN-C_screen.pdf)

Please note that the capabilities of indicating energy value are not restricted to instruments by Anton Paar. There are many others available (eg. FermentoFlash by Funke & Gerber, and others). All these devices can also provide the brewer with a read-out of the calories. You should contact your supplier to see what instruments and devices are at their disposal and how best they could help you to determine the calorific content of your beer.

D. CALCULATION METHOD – ENERGY VALUE - THE SCANDINAVIAN SCHOOL OF BREWING

The Scandinavian School of Brewing has developed an online calculator that allows brewers, on the basis of two inputs (for example the alcohol by volume (% abv) and the Real Extract) to calculate the energy value (kcal and kJoul per 100ml). The Scandinavian Beer Calculator can be accessed via this web link: http://www.beercalc.com/. It is a software program allowing for the calculation of a composition of beer (or wine) based upon only two inputs (several combinations are possible).

The Scandinavian Beer Calculator

- Requires two inputs (for example):
  - The Real Extract (Extract in Original Wort, in % Plato, g/100 g);
  - The alcohol content (Alcohol content by volume, in %, ml/100 ml);
- Allows calculating:
  - The nutritive Value of Beer, in kJoule/100 ml;
  - The Calorific Value of Beer, in kCal/100 ml

E. CALCULATION METHOD – ENERGY VALUE - THE QUICK CALCULATION METHOD

The Quick Calculation Method was developed by EBC and its members (brewers and brewing technologists) in cooperation with The Brewers of Europe and is useful for end-fermented beer with no sugar addition. In essence, this means that for a rough estimate of calorific value, only the residual extract (equating to carbohydrate) and alcohol content (ABV) needs to be known since there is virtually no fat and the amount of protein is sufficiently small to be disregarded. This alleviates the need for a nitrogen analysis altogether. Care must be taken to convert the apparent residual extract to real residual extract in g/l. The grams are then multiplied by 4: There are 4 kcal energy per g carbohydrate. Similarly, the ABV is converted to alcohol by weight (ABW, as expressed in grams). The figure thus obtained is multiplied by 7: There are 7 kcal energy per g ethanol.

The conversion figures are referenced on page 5 of this document as well as contained both in Method 9.45. and in the algorithms of the various extract measurement devices discussed above.

F. CALCULATION METHOD –THE BIG 7 – EBC METHOD 9.45.

EBC 9.45. describes a mathematical procedure to calculate the energy value of beer from the sum of the energy values of the significant beer components (alcohol, carbohydrates, protein) as determined by other methods. A brief description of that method and of the other methods referred to in this section is available in the ANNEXES on page 25.

ALCOHOL DETERMINATION (9.2.1 OR 9.2.4)

Alcohol can be quantified in beer by the distillation of the alcohol to yield a substrate devoid of alcohol, then measuring the density of the remaining liquid and accounting for the difference in density via weight and calculation (9.2.1.). This method is available in the ANNEXES on page29

Alcohol may also be quantified by gas chromatographic means (9.2.4.). This Metyod is available in the ANNEXES on page 33

PROTEIN CONTENT THROUGH NITROGEN DETERMINATION (9.9.1 OR 9.9.2)

Both these methods decribe the quantification of nitrogen in a sample of beer. 9.9.1. is an adaptation of the well-known Kjeldahl method (acidic digestion and measurement of nitrate); method 9.9.2. is the DUMAS combustion method. By analysing for nitrogen, a deduced value for protein content is calculated. A brief description of both method is available in the ANNEXES on pages 39 and 41.

CARBOHYDRATE CONTENT OF BEER – EBC 9.26

Carbohydrates in beer are derived from malt and brewing adjuncts, such as cereals or syrups. During the production of wort, the composition of the carbohydrate spectrum (fermentable sugars and non-fermentable dextrins) is fixed as a result of wort boiling which terminates any enzymatic (amylolytic) activity. The analysis of all carbohydrates remaining in the final beer is important to be determined from a nutritional point of view since it contributes to the final energy content of beer. The method described is based on the quantification of carbohydrates in beer using spectrophotometry. This Method is available in the ANNEXES on page 44.

G. CALCULATION METHOD – THE "BIG 7" – THE EXCEL CALCULATION TOOL

A shortened version of method 9.45. allows for the calculation to calculate the "Big 7" on the basis of the following data, some of which should be available to brewers, some of which would have to be retrieved from a laboratory analysis. There are two sub-methods: option 1 and option 2, for completion of this derived method. It is particularly useful for end-fermented beer with no sugar addition

The Excel Calculation Tool has been developed as an Excel-table that can be used to obtain the nutritional values. The user just has to fill in the data that are required.

The Excel Calculation Tool (2 Options)

Both allow calculating:

- The energy value (kcal/kJoul)
- The carbohydrates
- Proteins
- Salt

Fat and saturated fat are assumed to be of "0g per 100ml". The level of sugar is not calculated via the tool and is indicated as "0g per 100ml", potentially slightly underestimating the right sugar content.

	Available to brewers	Through analysis
Option 1 requires	Original extract Apparent extract	Total nitrogen Sodium
Option 2 requires	Real extract Alcohol (abv) Specific gravity	Total nitrogen Sodium

This method provides for accurate data, although some discrepancies against data retrieved from laboratory analysis were observed for the levels of sugars, where a specific attention should be considered.

ROUNDING AND TOLERANCES

The Commission has published a guidance document on tolerances and rounding that apply to the declaration of the nutritional values. The Guidance is not a legal document but can be used by control authorities of Member States when controlling for the accuracy of the values shared with consumers.

When it comes to beer for which no health or nutrition claim is made, sections 3 and 6 of the Guidance apply. They are developed and illustrated via concrete examples later on in this toolkit.

This section presents the guidance the Commission issued in 2012 regarding rounding rules and tolerances. It is illustrated by imaginary but concrete examples to better understand how the rounding and tolerances work.

ROUNDING

The rounding rules for the nutrition declaration for food are defined in Section 6 on the EC Guidance Document on Tolerances and Rounding. They cover both:

- The rounding rules;
- The amounts of nutrients that can be regarded as negligible and can be declared as "0" or as "<Xg" or as "contains negligible amounts of".

The table here below presents the rounding rules for the different nutrients that must be declared for beer in the context of the full nutritional declaration (the "Big 7").

Nutritional element	Amount	Rounding
Energy		To nearest 1 kJ/kcal (no decimals)
Fat, carbohydrate, sugars, protein	≥10g per 100g or ml	To nearest 1g (no decimals)
	<10g and >0.5g per 100 g or ml	To nearest 0.1g
	No detectable amounts is present or concentration is ≤0.5g per 100g or ml	"0g" or "<0.5g" may be declared
Saturates	≥10g per 100g or ml	To nearest 1g (no decimals)
	<10 and >0.1 g per 100g or ml	To nearest 0.1g
	No detectable amounts is present or concentration is ≤0.1g per 100g or ml	"0g" or "<0.1g" may be declared Alternatively, "contains negligible amounts of…" may be labelled
Salt	≥1g per 100g or ml	To nearest 0.1g
	<1g and >0.0125g per 100g or ml	To nearest 0.01g
	No detectable amounts is present or concentration is ≤0.0125g per 100g or ml	"0g" or "<0.01g" may be declared Alternatively, "contains negligible amounts of…" may be labelled

Please find here below a series of illustrative examples of how the rounding would take place.

Example 1

Nutritional Element	Analysed/Calculated data		Rounding	
Energy	48.75 kcal	204.10 kJ	49 kcal	204 kJ
Fat	0		0 OR <0.5g OR "contains negligible amount of fat"	
Saturates	0		0 OR <0.1g OR "contains negligible amount of saturates"	
Carbohydrates	3.27 g		3.3 g	
Sugars	3.14 g		3.1 g	
Protein	0.56 g		0.6 g	
Salt	0.0112 g		0 g OR <0.01g OR "contains negligible amounts of salt"	

Please note that in case the product contains negligible amounts of several nutrients, the way the nutritional declaration is presented may vary, meaning that the "Big 7" does not have to be listed (be in in a linear or tabular format" in the same order. Two ways are possible:

- Either using the order as prescribed by the Regulation AND mentioning figures (such as "0 g" OR " < X g");
- Or only mentioning, in the prescribed order, the nutrients for which figures are available and list at the end the nutrients for which the product only contains negligible amounts.

Concretely, the nutrition declaration for example 1 beer could look two ways as follows:

<table>
<tr><th></th><th>With figures for all nutrients</th><th>With figures for some nutrients AND “contains negligible amounts of” for the other nutrients</th></tr>
<tr><td>Tabular format</td><td>
<table>
<tr><th colspan="2">Nutrition declaration (per 100ml)</th></tr>
<tr><td>Energy</td><td>49kcal/204kJ</td></tr>
<tr><td>Fat</td><td>0 g</td></tr>
<tr><td>Of which Saturates</td><td>0 g</td></tr>
<tr><td>Carbohydrates</td><td>3.3 g</td></tr>
<tr><td>Of which sugars</td><td>3.1 g</td></tr>
<tr><td>Proteins</td><td>0.6 g</td></tr>
<tr><td>Salt</td><td>0 g</td></tr>
</table>
OR
<table>
<tr><th colspan="2">Nutrition declaration (per 100ml)</th></tr>
<tr><td>Energy</td><td>49kcal/204kJ</td></tr>
<tr><td>Fat</td><td>< 0.5 g</td></tr>
<tr><td>Of which Saturates</td><td>< 0.1 g</td></tr>
<tr><td>Carbohydrates</td><td>3.3 g</td></tr>
<tr><td>Of which sugars</td><td>3.1 g</td></tr>
<tr><td>Proteins</td><td>0.6 g</td></tr>
<tr><td>Salt</td><td>< 0.01 g</td></tr>
</table>
</td><td>
<table>
<tr><th colspan="2">Nutrition declaration (per 100ml)</th></tr>
<tr><td>Energy</td><td>49kcal/204kJ</td></tr>
<tr><td>Carbohydrates</td><td>3.3g</td></tr>
<tr><td>Of which sugars</td><td>3.1g</td></tr>
<tr><td>Proteins</td><td>0.6g</td></tr>
<tr><td colspan="2">Contains negligible amounts of fat, saturates and salt</td></tr>
</table>
</td></tr>
<tr><td>Linear format</td><td>Nutrition declaration (per 100ml): Energy: 49kcal/204kJ, Fat: 0 g, of which saturates: 0g, carbohydrates: 3.3g, of which sugars: 3.1g, proteins: 0.6g, salt: 0g
OR
Nutrition declaration (per 100ml): Energy: 49kcal/204kJ, Fat: <0.5g, of which saturates: <0.1g, carbohydrates: 3.3g, of which sugars: 3.1g, proteins: 0.6g, salt: <0.01g</td><td>Nutrition declaration (per 100ml): Energy: 49kcal/204kJ, carbohydrates: 3.3g, of which sugars: 3.1g, proteins: 0.6g, contains negligible amounts of fat, saturates and salt.</td></tr>
</table>

Example 2

Nutritional Element	Analysed/Calculated data		Rounding	
Energy	85,48kcal	357,88kJ	85kcal	358kJ
Fat	0 g		0 OR <0.5g OR "contains negligible amount of fat"	
Saturates	0 g		0 OR <0.1g OR "contains negligible amount of saturates"	
Carbohydrates	11,33 g		11g	
Sugars	10,69 g		11g	
Protein	0,34 g		0g OR <0.5g or "contains negligible amounts of protein"	
Salt	0, 026 g		0.03g	

Please note that in case the product contains negligible amounts of several nutrients, the way the nutritional declaration is presented may vary, meaning that the "Big 7" does not have to be listed (be in in a linear or tabular format" in the same order. Two ways are possible:

- Either using the order as prescribed by the Regulation AND mentioning figures (such as "0 g" OR " < X g");
- Or only mentioning, in the prescribed order, the nutrients for which figures are available and list at the end the nutrients for which the product only contains negligible amounts.

Concretely, the nutrition declaration for example 2 beer could look two ways as follows:

<table>
<tr><th></th><th>With figures for all nutrients</th><th>With figures for some nutrients AND “contains negligible amounts of” for the other nutrients</th></tr>
<tr><td>Tabular format</td><td>
<table>
<tr><th colspan="2">Nutrition declaration (per 100ml)</th></tr>
<tr><td>Energy</td><td>85kcal/358kJ</td></tr>
<tr><td>Fat</td><td>0 g</td></tr>
<tr><td>Of which Saturates</td><td>0 g</td></tr>
<tr><td>Carbohydrates</td><td>11 g</td></tr>
<tr><td>Of which sugars</td><td>11 g</td></tr>
<tr><td>Proteins</td><td>0 g</td></tr>
<tr><td>Salt</td><td>0.03 g</td></tr>
</table>
OR
<table>
<tr><th colspan="2">Nutrition declaration (per 100ml)</th></tr>
<tr><td>Energy</td><td>85kcal/358kJ</td></tr>
<tr><td>Fat</td><td>< 0.5 g</td></tr>
<tr><td>Of which Saturates</td><td>< 0.1 g</td></tr>
<tr><td>Carbohydrates</td><td>11 g</td></tr>
<tr><td>Of which sugars</td><td>11 g</td></tr>
<tr><td>Proteins</td><td>< 0.5 g</td></tr>
<tr><td>Salt</td><td>0.03 g</td></tr>
</table>
</td><td>
<table>
<tr><th colspan="2">Nutrition declaration (per 100ml)</th></tr>
<tr><td>Energy</td><td>85kcal/358kJ</td></tr>
<tr><td>Carbohydrates</td><td>11g</td></tr>
<tr><td>Of which sugars</td><td>11g</td></tr>
<tr><td>Salt</td><td>0.03g</td></tr>
<tr><td colspan="2">Contains negligible amounts of fat, saturates and proteins</td></tr>
</table>
</td></tr>
<tr><td>Linear format</td><td>Nutrition declaration (per 100ml): Energy: 85kcal/358kJ, Fat: 0 g, of which saturates: 0g, carbohydrates: 11g, of which sugars: 11g, proteins: 0g, salt: 0.03g

OR

Nutrition declaration (per 100ml): Energy: 85kcal/358kJ, Fat: <0.5g, of which saturates: <0.1g, carbohydrates: 11g, of which sugars: 11g, proteins: <0.5g, salt: 0.03g</td><td>Nutrition declaration (per 100ml): Energy: 85kcal/358kJ, carbohydrates: 11g, of which sugars: 11g, salt: 0.03g, contains negligible amounts of fat, saturates and proteins.</td></tr>
</table>

TOLERANCES

Section 3 of the Guidance Document refers to the tolerances for the declared nutritional values of foodstuff in case of controls by the competent national authorities. They have been developed to include the uncertainty of measurement and calculation associated with nutritional values as well as batch to batch variations. The rounding rules described here below also apply to the tolerances (meaning that the upper and lower tolerances also have to be rounded to give the full margin of tolerances compared to what is labelled (or shared with consumers via another platform).

The following table lists the tolerances for foodstuffs with regards to the full nutritional values (the "Big 7") but do not include "energy". As energy, when it comes to alcoholic beverages, is calculated on the basis of the alcohol content (amount of grams of alcohol per 100 ml multiplied by 7, added to the amount of grams of carbohydrates multiplied by 4 and the amount of proteins multiplied by 4 for calories – for kiloJoules, please look at the EC's conversion factors) and that there are tolerances for two of the values (carbohydrates and proteins), we consider that a certain tolerance is also given for energy. This should however be cleared with competent national authorities.

Nutritional element	Amount declared on the label (or shared via another platform with consumers)	Tolerances
Carbohydrate, sugars, protein	<10 g per 100g/ml	± 2g
	10-40g per 100g/ml	± 20%
	>40g per 100g	± 8g
Fat	<10g per 100g/ml	± 1.5g
	10-40g per 100g/ml	± 20%
	>40g per 100g	± 8g
Saturates	<4g per 100g/ml	± 0.8g
	≥4g per 100g/ml	± 20%
Salt	<1.25g per 100g/ml	± 0.375g
	≥1.25g per 100g/ml	± 20%

The two examples from the "rounding" section here above are used to illustrate how the tolerances would apply in case of control where the product would be lab-analysed and the analysed data would be compared to the data declared on the label (or any other platform used to share the information with consumers).

Example 1

Nutritional values	Amount declared on the label (or shared via another platform with consumers)	Tolerances rules that apply	According to rounding guidelines, the amounts covered may vary from … to …	Tolerances (upper and lower)	Tolerance range
Energy	49 204 kJ kcal	Not applicable	Not applicable	Not applicable	Energy
Fat	0 OR <0.5g OR "contains negligible amount of fat"	± 1.5g	0 to 0.5g	Lower = 0g Upper = 2g	0 to 2g
Saturated	0 OR <0.1g OR "contains negligible amount of saturates"	± 0.8g	0 to 0.1g	Lower = 0g Upper= 0.9g	0 to 0.9g
Carbohydrates	3.3 g	± 2g	3.25 to 3.34g	Lower = 1.25g rounded to 1.3g Upper= 5.34g rounded to 5.3g	1.3 to 5.3g
Sugars	3.1 g	± 2g	3.05 to 3.14 g	Lower = 1.05g rounded to 1.1g Upper = 5.14g rounded to 5.1g	1.1 to 5.1g
Protein	0.6 g	± 2g	0.55 to 0.64g	Lower = 0g Upper = 2.64g rounded to 2.6g	0 to 2.6g
Salt	0 g OR <0.01g OR "contains negligible amounts of salt"	± 0.375g	0 to 0.0125g	Lower = 0g Upper = 0.385g rounded to 0.4g	0 to 0.4g

If the data obtained after analysis by your national competent authorities are within the – rather wide – tolerance range, then you are in line with the rules established by the Commission.

Example 2

Nutritional values	Amount declared on the label (or shared via another platform with consumers)	Tolerances rules that apply	According to rounding guidelines, the amounts covered may vary from … to …	Tolerances (upper and lower)	Tolerance range
Energy	85kcal 358kJ	Not applicable	Not applicable	Not applicable	Energy
Fat	0 OR <0.5g OR "contains negligible amount of fat"	± 1.5g	0 to 0.5g	Lower = 0g Upper = 2g	0 to 2g
Saturated	0 OR <0.1g OR "contains negligible amount of saturates"	±0.8g	0 to 0.1g	Lower = 0g Upper= 0.9g	0 to 0.9g
Carbohydrates	11g	± 20%	10.5 to 11.4g	Lower= 8.4g Upper = 13.68g rounded to 14g	8.4 to 14g
Sugars	11g	± 20%	10.5 to 11.4g	Lower = 8.4g Upper = 13.68g rounded to 14g	8.4 to 14g
Protein	0g OR <0.5g or "contains negligible amounts of protein"	± 2g	0 to 0.5g	Lower = 0g Upper = 2.5g	0 to 2.5g
Salt	0.03g	±0.375g	0.025 to 0.034g	Lower = 0g Upper = 0.409g rounded to 0.41g	0 to 0.41g

If the data obtained after analysis by your national competent authorities are within the – rather wide – tolerance range, then you are in line with the rules established by the Commission.

LINKS

- Regulation 1169/2011 of the European Union on Food Information to Consumers – Link
- European Commission Guidance Document on Tolerances and Rounding – Link
- The Scandinavian Beer Calculator – Link
- The Brewers of Europe's Guidance on Nutrition Declaration - Link
- Links to some established and recognised food nutrition databases:
    - EuroFiR, which links back to 16 European, US and Canadian food composition databases: http://www.eurofir.org/foodexplorer/login1.php (free access for 15 days, but then subscription is necessary)
    - US Department of Agriculture Food Composition Databases: https://ndb.nal.usda.gov/ndb/search/list

ANNEXES

ANNEX 1 - EBC 9.45 : ENERGY VALUE OF BEER BY CALCULATION[2]

Abstract

A mathematical procedure to calculate the energy value of beer from the sum of the energy values of the significant beer components as determined by other methods.

1 Scope

A mathematical procedure to calculate the energy value of beer from the sum of the energy values of the significant beer components as determined by other methods.

2 Field of Application

2.1 The method can be applied to all beers.

2.2 The method is the official method for calculation of energy value (in kilocalories or kiloJoules; 1 kcal = 4,1868 kJ) (ASBC = 4,184, IOB 4,1855 and if you apply the kcal and kJ calculation formula, as example for a beer pilsner type, the ratio between the two results can be 4,182, because the ratio kJ/kcal is different for each sum's component: so for alcohol 29/7 = 4,143, for arbohydrates 7/4 = 4,250 and for protein 17/4 = 4,250) for labelling of beverages to meet the requirements of the EC Directive 90/496/EEC, Nutritional Labelling Rules, definition of Energy Value.

2.3 The kilocalorie in nutritional science is commonly referred to as the calorie or "large" calorie and is based on the 15 °C calorie.

2.4 It should be noted that EBC Method 9.26 does not include a full contribution from any pentosans present. If a full spectrum of non-fermented mono-, di- and tri-saccharides is to be aimed for, there are various methods available using HPLC (see 3.8 & 3.9) or a method developed by Marie Jurková & Pavel Čejka & Karel Štěrba & Jana Olšovská. (see 3.10). However, this is usually not necessary in beers which are fully fermented at the limit of attenuation (almost all beers are always fully fermented to "dryness") or for those, which have no extra carbohydrates added for sweetening purposes.

2.5 If it is thought that the product contains significant quantities of polyols (e.g. glycerol) then EBC Method 9.33 is available and the EC factors below for converting polyols must be used and the energy added to the total obtained in 6.1
Energy E (kcal/100 ml) = glycerol (g/100 ml) x 2,4 Energy E (kJ/100 ml) = glycerol g/100 ml) x 10

3 References

3.1 EBC Method 9.2.1 (Beer: Alcohol in Beer by Distillation).

3.2 EBC Method 9.2.4 (Beer: Ethanol in Beer by Gas Chromatography).

3.3 EBC Method 9.26 (Beer: Total Carbohydrate in Beer by Spectrophotometry).

3.4 EBC Method 9.9.1 (Beer: Total Nitrogen in Beer: Kjeldahl Method).

3.5 EC Directive (90/496/EEC) Nutritional Labelling Rules.

3.6 Rosendal, I. and Schmidt, F., The Alcohol Table for Beer Analysis and Polynomials for Alcohol and Extract, Journal of The Institute of Brewing, 1987, 93, 373.

[2] Analytica-EBC, Fachverlag Hans Carl, Andernacher Str. 33a, D-90411 Nürnberg, Germany

3.7 International Organization of Legal Metrology, International Recommendation No. 22, Alcoholometry "International alcoholometric tables", Table Va, First edition, Paris 1973.

3.8 Nogueira, LC, Silva, F., Ferreira, IM, Trugo, LC. Separation and quantification of beer carbohydrates by high-performance liquid chromatography. J. Chromatogr. A.: 2005 Feb 18;1065(2):207-10.

3.9 Wei, Y, Ding, MY. Analysis of carbohydrates in drinks by high-performance liquid chromatography. J. Chromatogr. A.: 2000 Dec 22;904(1):113-7.

3.10 Jurková, M, Čejka, P, Štěrba K, Olšovská, J. Determination of Total Carbohydrate Content in Beer Using Its Pre-column Enzymatic Cleavage and HPLC-RI. Food Anal. Methods (2014) 7:1677–1686.

4 Principle

The energy value is calculated from the sum of the energy values of the significant beer components: alcohol, total carbohydrate and protein. These determinations are made using EBC methods 9.2.1 or 9.2.4, 9.26 and 9.9.1 respectively.

5 Procedure

5.1 Determine the alcohol content of the beer as % (m/m) by the appropriate EBC Method 9.2.1 or 9.2.4 for the determination of alcohol.

5.1.1 Recalculate the alcohol content of the beer in % (m/m) according to the formula below and express the result as alcohol A in g/100 ml.

Alcohol A [g/100 ml] = alcohol [% (m/m)] x ρ

where ρ is the density of the beer at 20 °C (see 3.5 and 3.6).

5.2 Determine the total carbohydrate content of the beer in g/100 ml as glucose by EBC Method 9.26.

5.3 Determine the total nitrogen content of the beer in mg/litre by EBC Method 9.9.1.

5.3.1 For conversion to protein use the formula:

Protein (g/100 ml) = [Total N (mg/litre) x 6,25]/10000 = Total N (mg/litre) x 6,25 x 10^{-4}

6 Expression of Results

6.1 Calculation
The energy value can be calculated either in kilocalories (kcal) or in kiloJoules (kJ) using factors prescribed in EC Directive (90/496/EEC):

Energy E (kcal/100 ml) = (A x 7) + (C x 4) + (P x 4)
Energy E (kJ/100 ml) = (A x 29) + (C x 17) + (P x 17)

or using the total nitrogen content of the beer as a measure of the protein content:

Energy E (kcal/100 ml) = (A x 7) + (C x 4) + (N x 0,0025)
Energy E (kJ/100 ml) = (A x 29) + (C x 17) + (N x 0,0106)

where
A = alcohol, in g/100 ml
C = carbohydrate, in g/100 ml as glucose
P = protein, in g/100 ml
N = total N, in mg/litre

6.2 Report the result in kcal or kJ to one decimal place.

6.3 As an alternative to the official EC method an estimated energy value can be calculated from the alcohol and real extract values of the beer (see 7.3).

Energy value E (kcal/100 ml) = density of the beer (g/ml) x (3.5 x E_r + 7 x A)

or

Energy value E (kJ/100 ml) = density of the beer (g/ml) x (15 x E_r + 29 x A)

where
E_r = real extract, in % m/m
A = alcohol, in % m/m

6.4 Precision

6.4.1 The precision of the determination of the energy value by calculation has been evaluated by application of "Quantifying Uncertainty in Analytical Measurement" (see 7.4). The reported uncertainty (U) (see 7.2) is an expanded uncertainty calculated using a coverage factor of 2 which gives a level of confidence of approximately 95 %.

6.4.1.1 For repeatability

$U\ (kcal/100\ ml) = 2 \times \{(5{,}625.10^{3} + 1{,}875.10^{-3} \times A + 1{,}56.10^{-4} \times A^{2}) + (3{,}265.10^{-3} + + 3{,}265.10^{-3} \times C + 8{,}16.10^{-4} \times C^{2}) + (3{,}906.10^{-5} + 1{,}339.10^{-7} \times N + 1{,}148.10^{-10} \times N^{2})\}^{1/2}$

or
$U\ (kJ/100\ ml) = 2 \times \{(9{,}65.10^{-2} + 0{,}0322 \times A + 2{,}68.10^{-3} \times A^{2}) + (5{,}8976.10^{-2} + + 5{,}8976.10^{-2} \times C + 1{,}47.10^{-2} \times C^{2}) + (7{,}02.10^{-4} + 2{,}407.10^{-6} \times N + 2{,}063.10^{-9} \times N^{2})\}^{1/2}$

And then, the reporting energy content should be made as:

E ± U in kcal/100 ml or kJ/100 ml

6.4.1.2 For reproducibility

$U\ (kcal/100\ ml) = 2 \times \{(5{,}625.10^{-3} + 7{,}5.10^{-3} \times A + 2{,}5.10^{-3} \times A^{2}) + (1{,}27.10^{-1} \times C^{2}) + (7{,}97.10^{-5} + 7{,}97.10^{-7} \times N + 1{,}99.10^{-9} \times N^{2})\}^{1/2}$

or

$U\ (kJ/100\ ml) = 2 \times \{(0{,}0965 + 0{,}1287A + 0{,}0429A^{2} + 2{,}3037 \times C^{2} + 1{,}433.10^{-3} + 1{,}433.10^{-5} \times N + 3{,}58.10^{-8} \times N^{2})\}^{1/2}$

And then, the reporting energy content should be made as:

E ± U in kcal/100 ml or kJ/100 ml

6.4.2 Precision values (U) calculated from the errors of the component analysis are dependent for normal beers mainly upon the level of carbohydrate in the beer.

6.4.3 As a guide, in an IOB Analysis Committee collaborative trial (see 7.1), where 10 laboratories made single determinations on 4 beers in kcal/100 ml, the mean precision values were:

Beer Type	Carbohydrate (g/100 ml)		U
Diät/Lite		0,7	2,02
Premium lager/pale ale	3 - 5	3,06	

7 Bibliography

7.1 Martin, P.A., Journal of The Institute of Brewing, 1982, 88, 320.

7.2 Appendix 1 to EBC Method 9.45 – Quantifying Uncertainty of Beer Energy. EBC archived data.

7.3 MEBAK Band II, 2002, Method 2.12, Physiologischer Brennwert.

7.4 Quantifying Uncertainty in Analytical Measurement, EURACHEM/CITAC Guide, Second Edition 2000.

7.5 Institute of Brewing Methods of Analysis, 1997, Method 9.30, Beer: Energy Value of Beer (Calculation).

7.6 EBC Method 9.33 (Beer: Glycerol in Beer: Enzymatic Method).

ANNEX 2 – EBC METHOD 9.2.1.3

Abstract

The determination of the alcohol content of beer using a distillation procedure and measurement of specific gravity of the distillate. Alternative procedures may produce accurate results but the distillation procedure is regarded as the reference method for alcohol.

Refer to Section 0 (Safety) for relevant warning and safety precautions.

1 Scope

1.1 The determination of the alcohol content of beer using a distillation procedure and measurement of specific gravity of the distillate.

1.2 Alternative procedures may produce accurate results but the distillation procedure is regarded as the reference method for alcohol.

2 Field of Application

2.1 The method can be applied to all beers with alcohol contents between 0,8 and 9,0 % V/V although may also be applicable to higher strength beers.

2.2 A correction has to be made for acidic beers because of the error due to the presence of volatile acids in the alcoholic distillate. If the acid is present as part of the character of the product then the correction should be made according to the DeClerck method (see 3.1). If microbiological contamination of the beer has occurred (e.g. in a beer sample returned by a customer) and the acid is present as a result of conversion of the beer alcohol to acid by beer spoilage organisms the correction should be made according to EBC Method 9.2.5 (see 3.2).

3 References

3.1 De Clerck, Cours de Brasserie, 2nd ed., 1963, vol. 2, 690.

3.2 EBC Method 9.2.5 (Beer: Correction for Volatile Acidity).

3.3 EBC Method 9.43.1 (Beer: Specific Gravity of Beer using a Pyknometer) or EBC Method 9.43.2 (Beer: Specific Gravity of Beer using a Density Meter).

3.4 EBC Method 9.46 (Beer: Degassing of Beer)

3.5 International Document, Conventional value of the result of weighing in air, OIML D 28, 2004.

3.6 International Recommendation, International alcoholometric tables, Table Va, OIML R 22, 1975.

3.7 International Standard, Water for analytical laboratory use – Specification and test methods, ISO 3696:1987.

[3] Analytica-EBC, Fachverlag Hans Carl, Andernacher Str. 33a, D-90411 Nürnberg, Germany

4 Principle

4.1 The beer is degassed and filtered avoiding loss of alcohol content from evaporation but ensuring that all carbon dioxide is removed so that it cannot interfere in the analysis (see 3.4).

4.2 The alcohol is separated by distillation using direct heating.

4.3 The specific gravity at 20/20 °C of the alcoholic distillate is determined after making it up to its original weight with water.

4.4 From this value, the % alcohol (m/m) is obtained using the OIML table or the polynomial formula derived from it.

4.5 The specific gravity of the filtered beer is determined in order to convert alcohol % (m/m) to % (V/V).

5 Reagent

Use water of at least grade 3 as defined in ISO 3696:1987.

6 Apparatus

6.1 Distilling flasks, 300 to 500 ml.

6.2 Entrainment trap (Kjeldahl type) fitted between the distilling flask and the condenser, either spherical or cylindrical is suitable.

6.3 Vertical condenser, Graham, Thorpe, Liebig or Allihn type, with a jacket at least 400 mm long. The inner tube must be such that it can reach into the bottom of the flask. It must have a safety bulb above the level of the neck of the flask. The condenser is cooled using tap water (11-13 °C).

6.4 Volumetric flask, 100 ml.

6.5 Top pan balance, capable of weight to ±0,01 g up to 0,5 kg or equivalent.

6.6 Heating source, “asbestos” type gauze, gas burner or electrical heater, 2 kW with continuous energy regulation.

7 Preparation of Samples

7. 1 Remove excess carbon dioxide by shaking by hand about 300 to 500 ml of beer in a 1000 ml stoppered flask at a temperature of about 20 ºC. Shake gently at first and then vigorously until gases no longer escape from the beer. During shaking the flask is kept closed.

7.2 Filter the beer into a second flask through a dry filter paper in a filter funnel covered with a clock glass. Reject the first 20 ml.

7.3 Repeat this shaking and filtering step to be sure that the beer is completely degassed taking care not to lose alcohol.

8 Procedure

8.1 Weigh 100,0 g (±0,1 g) of the decarbonated beer into a (tared) 300 to 500 ml distilling flask and then add about 50 ml of water. Attach the flask to an entrainment trap followed by a condenser. Ensure that the exit end of the condenser dips into about 5 ml of water in a tared 100 ml flask surrounded with ice or ice and water in warm atmospheres. Stand the distillation flask on the heating source and apply heat to distil off the alcohol at a uniform rate. Avoid carbonization of the liquid and losses of alcohol. Stop the distillation when 85 to 90 ml have been collected (between 30-60 min). Use a few ml of water to rinse any liquid from the inside of the condenser to the receiver.

8.2. Make the contents of the receiver up to 100,0 g ± 0,1 g with water. Mix the contents of the flask thoroughly.

8.3 Measure the specific gravity 20/20 °C of the distillate, SGA, to 5 decimal places using a pyknometer or a density meter (see 3.3).

8.4 Measure the specific gravity 20/20 °C of the decarbonated beer, SGEA, to 5 decimal places using a pyknometer or a density meter (see 3.3).

9 Calculation and Expression of Results

9.1 Alcohol as % (m/m)

9.1.1 Convert the specific gravity of the distillate, SGA, to the corresponding alcohol content, A, as % (m/m) in accordance with the OIML table (3.5 and 3.6 or 11.2) or by using the polynomial formula (11.1):

Alcohol content (A) in distillate = 517,4 (1 - SGA) + 5084 (1 - SGA)2 + 33503 (1 - SGA)3

Alcohol content of the distillate = alcohol content of the beer.

9.1.2 Report the alcohol content as % (m/m) to 2 decimal places.

9.2 Alcohol as % (V/V)

9.2.1 Convert the alcohol content, A, as % (m/m) to the alcohol content as % (V/V) using the following formula:

where

SGEA = specific gravity of decarbonated beer (8.4)

0,791 = specific gravity of ethanol at 20/20 °C

9.2.2 Report the alcohol content as % (V/V) to 2 decimal places.

10 Precision

The precision values given below were determined from the data of two collaborative trials carried out by the EBC Analysis Committee, one in 1995/1996 for Alcohol Content by Distillation, Refractometry, Gas Chromatography and Catalytic Combustion in which 18 to 20 laboratories analysed 12 beers samples at 6 levels and the other one in 1996 for Original, Real and Apparent Extract in which 13 laboratories analysed 6 beer samples at 6 levels. of the flask. It must have a safety bulb above the level of the neck of the flask. The condenser is cooled using tap water (11-13 °C).

10.1 1995/1996 trial Alcohol in % (V/V)

Range	r95	R95
0,84 to 7,27	0,062	0,07 + 0,02 m

10.2 1996 trial

10.2.1 Alcohol in % (m/m)

Range	r95 [% (V/V)]	R95 [% (V/V)]
1,72 to 7,00	0,03 + 0,005 m	0,03 + 0,02 m

where m is the mean value.

10.2.2 Alcohol in % (V/V)

Range	r95	R95
2,20 to 8,95	0,04 + 0,004 m	0,04 + 0,02 m

where m is the mean value.

11 Bibliography

11.1 Rosendal, I. and Schmidt, F., The Alcohol Table for Beer Analysis and Polynomials for Alcohol and Extract, Journal of The Institute of Brewing, 1987, 93, 373.

11.2 Laboratory Alcohol Table, Density/Strength at 20 ºC for laboratory use, HM Custom and Excise, London 1979

11.3 Bénard, M., Journal of The Institute of Brewing, 2000, 106, 135.

ANNEX 3 – EBC METHOD 9.2.4.4

Abstract

The determination of the ethanol content of beer by gas liquid chromatography using direct liquid injection.

Refer to Section 0 (Safety) for relevant warning and safety precautions.

1 Scope

The determination of the ethanol content of beer by gas liquid chromatography using direct liquid injection.

2 Field of Application

2.1 The method can be applied to all beers. Quantified precision values were obtained over the range of 0,007 to 7,24 % (V/V). Beers with higher levels of ethanol can be analysed provided they are diluted to bring them within the linear range of the detector.

2.2 The method is specific to ethanol and is free from interference from other alcohols.

3 References

3.1 EBC Method 1.4 (Apparatus: Care and Adjustment of Apparatus: Gas Chromatographs).

3.2 EBC Method 9.2.1 (Beer: Alcohol in Beer by Distillation).

3.3 EBC Method 9.43.1 (Beer: Specifi c Gravity of Beer using a Pyknometer) or 9.43.2 (Beer: Specific Gravity of Beer using a Density Meter).

3.4 Instruction Manual for the GC equipment in question.

3.5 International Document, Conventional value of the result of weighing in air, OIML D 28, 2004.

3.6 International Recommendation, International alcoholometric tables, Table Va, OIML R 22, 1975.

3.7 International Standard, Water for analytical laboratory use – Specification and test methods, ISO 3696:1987.

[4] Analytica-EBC, Fachverlag Hans Carl, Andernacher Str. 33a, D-90411 Nürnberg, Germany

4 Principle

4.1 The beer is degassed, avoiding loss of alcohol content by evaporation, ensuring that all carbon dioxide is removed such that it cannot interfere in the analysis.

4.2 The degassed and filtered sample is diluted with a known quantity of an internal standard (n-butanol).

4.3 The ethanol present in the diluted sample is separated, after liquid injection, on a gas liquid chromatographic column and detected by a fl ame ionization detector.

4.4 From the chromatogram, the ratio of the height/ area of the ethanol peak to the height/area of the internal standard is compared to the ratios of the same peaks obtained from the analysis of standards of known ethanol concentration.

5 Reagents

5.1 Unless otherwise specified, use only reagents of recognized analytical grade and water of at least grade 3 as defined in ISO 3696:1987.

5.2 Ethanol, absolute [> 99,8 % (V/V)]. Lower concentrations may be used provided the purity is known.

5.3 Standard ethanol solutions

5.3.1 Prepare 3 to 4 standard ethanol solutions for calibration purposes from absolute ethanol to cover the range of ethanol content that is likely to be encountered in the samples by weighing the appropriate amount of absolute ethanol into a volumetric flask and making to the mark with water. Make a note of the exact weight of ethanol taken for the preparation of each standard.

5.3.2 Determine the specific gravity of the ethanol standard solutions by an established densitometric or pyknometric method (see 3.3). Determine and record the exact concentration of ethanol in % (m/m) and/or % (V/V) from the specifi c gravity by reference to the OIML table or polynomial formula in 3.5 and 3.6 or in 10.1 and 10.2.

5.3.3 The alcohol solutions can be stored in sealed glass bottles at 0–4 ºC.

5.3.4 Standard reference ethanol solutions are available e.g. from the Laboratory of the UK Government Chemist.

5.4 n-Butanol internal standard. (Alternatively use either 2-butanol, n-pentanol or n-propanol.) New batches must be checked chromatographically to ensure that there are no interferences with the ethanol peak.

5.4.1 For analysis of beers < 1,0 % (V/V) ethanol, n-butanol 0,25 to 0,35 % (m/m), internal standard is made up as follows: weigh 2,50 to 3,50 g of n-butanol into a 1000 ml volumetric flask, make up to 1000,0 g with water. Stopper and shake well. Make a note of the exact weight taken.

5.4.2 For analysis of beers > 1,0 % (V/V) ethanol, nbutanol 0,50 % (V/V), internal standard is made up as follows: pipette 10,0 ml of n-butanol at 20,0 ± 0,1 ºC into a 2 litre volumetric flask and dilute to volume with water at 20,0 ± 0,1 ºC. Stopper and shake well.

5.5 Standard beers with known concentration of alcohol as determined by a reference method (see 3.2) covering the alcohol content of subsequent samples to be analysed.

6 Apparatus

6.1 Gas chromatograph, fitted with a fl me ionization detector. The gas chromatography system employed must be capable of achieving baseline separation of ethanol and n-butanol peaks.

6.2 Chromatography column,
- 1,5 to 2 m × 2 to 4 mm i.d., glass or stainless steel packed with Porapak Q, Chromosorb or Carbowax,
- 30 to 60 m × 0,25 to 0,53 mm i.d. × 0,25 to 1 µm packed with WAX or FFAP. Other packed or capillary columns may be used.

6.3 Computing integrator, chart recorder and integrator or equivalent.

6.4 Syringe 0,5–1,0 µl. Gas tight positive displacement syringe or

6.4.1 Autosampler for the gas chromatograph to inject 0,5-1,0 µl of liquid sample.

6.4.2 Vials, to fit the autosampler.

6.5 Volumetric flasks, 1 litre, grade B.

6.6 Top pan balance, capable of weighing to ± 0,005 g up to 1,5 kg.

6.7 Filter funnels.

6.8 Filter papers, folded and dry (Whatman No. 1; S & S 5600 or equivalent).

6.9 Clock glasses.

6.10 Conical flasks, 50 ml, 150 ml and 300 ml.

6.11 Auto diluter, capable of diluting to 10 ± 0,1 % or

6.11.1 Pipettes, grade A, 1 ml, 2 ml, 5 ml, 10 ml and 20 ml.

6.11.2 Volumetric flasks, grade A, 100 ml , 250 ml and 2 litres.

6.12 Water bath, controlled to 20,0 ± 0,1 ºC.

7 Preparation of Samples

7.1 Remove excess carbon dioxide by shaking by hand 100 to 200 ml of beer in a 300 ml conical flask at a temperature of 17 to 20 ºC. Shake gently at first and then vigorously until gases no longer escape from the beer. During shaking keep the flask closed.

7.2 Filter the beer through a dry filter paper in a funnel, covered with a clock glass, into a second flask. Reject the first 20 ml of filtrate.

7.3 Repeat this shaking and filtering step until the beer is completely degassed.

8 Procedure

8.1 Preliminary check test

8.1.1 Start up and condition the instrument according to the manufacturer's operating instructions (see 3.4).

8.1.2 Use – if it is available – the troubleshooting menu commands to ensure that the equipment is in good working order.

8.2 Calibration

8.2.1 Adjust the gas chromatograph according to the determination's procedure given in 8.3.1.

8.2.2 Diluting and mixing

8.2.2.1 For beers < 1,0 % (V/V) alcohol, weigh into clean, dry vials one aliquot part of each attemperated standard ethanol solution and the same amount of 0,3 % n-butanol internal standard solution (5.4.1) (e.g. 1,00 g + 1,00 g). Stopper and mix thoroughly.

8.2.2.2 For beers > 1,0 % (V/V) alcohol, dilute 2 ml of each ethanol standard solution with 20 ml of the 0,5 % n-butanol internal standard solution (5.4.2) using an autodiluter or by pipetting, into a clean, dry 50 ml conical flask. Ensure that both solutions are at 20,0 ± 0,1 ºC before diluting. Temperature accuracy at this stage is critical to the accuracy of the method. Stopper and mix thoroughly.

8.2.3 Inject 0,5 or 1,0 µl of the standard ethanol solution of lowest concentration from 8.2.2 into the gas chromatograph.

8.2.4 Determine the areas of the ethanol and n-butanol standard peaks.

8.2.5 Repeat steps 8.2.3 and 8.2.4 for each ethanol solution.

8.3 Determination

8.3.1 Prepare the gas chromatograph according to the manufacturer's instructions. Typical conditions:

Oven temperature: 100–180 ºC.
Isothermal.

Injection temperature: 150–250 ºC.
Set approximately 50 ºC above the temperature of the column.

Detector temperature: 200–300 ºC.
Set > 50 ºC above the temperature of the injector.

Carrier gas: helium or nitrogen
- flow rate: 5–45 ml/min.

FID gases: hydrogen and air
- flow rates: 24–40 ml/min and 250–450 ml/min or as required to produce optimum sensitivity.

8.3.1.1 Other gas chromatograph conditions may be employed provided good chromatography is obtained.

8.3.1.2 Condition a new column by an established procedure.

8.3.2 Dilution and mixing

8.3.2.1 For beers < 1,0 % alcohol (V/V), weigh in clean, dry vials one aliquot part of each beer to test and the same amount of 0,3 % n-butanol internal standard solution (5.4.1) (e.g. 1,00 g + 1,00 g). Stopper and mix thoroughly.

8.3.2.2 For beers > 1,0 % alcohol (V/V), dilute 2 ml of the beer sample with 20 ml of 0,5 % n-butanol internal standard solution (5.4.2) using the same equipment as for the ethanol standards, into a clean, dry 50 ml conical flask. Temperature accuracy at this stage is critical to the accuracy of the method. Stopper and mix thoroughly.

8.3.3 Inject 0,5 or 1,0 µl of the beer dilutions from

8.3.2 into the gas chromatograph.

8.3.4 Determine the areas of the peaks due to the beer ethanol and n-butanol internal standard.

9 Calculation and Expression of Results

9.1 Calculation

9.1.1 Calibration equation

9.1.1.1 Plot a graph of:

area of ethano peak

area of internal standard peak

against ethanol concentration % (m/m) or % (V/V) from the results obtained for each of the standard ethanol solutions (8.2.4). The graph should be linear and should pass through the origin.

9.1.1.2 Fit using linear regression, the best straight line to the graph. Calculate the coefficient of correlation (r) and provided r > 0,99, calculate the gradient to give the factor F:

$$F = \frac{\text{ethanol concentration \% (m/m) or \% (V/V)}}{\text{area of ethanol peak/area of internal standard peak}}$$

Once the linearity of the calibration range is established, subsequent calibrations to determine the factor F, can be performed by carrying out triplicate determination of the standard nearest to the expected concentration.

9.1.2 Beer samples

9.1.2.1 From the results obtained in each beer sample, calculate the peak area ratio:

area of ethanol peak

area of internal standard peak

9.1.2.2 And then the % (m/m) or % (V/V) of ethanol content by multiplying by the factor F:

$$\text{Ethanol [\% (m/m) or \% (V/V)]} = \frac{\text{area of ethanol peak}}{\text{area of internal standard peak}} \times F$$

9.1.2.3 Optionally convert the ethanol content as % (m/m) to % (V/V) or vice versa using the following formula:

$$\text{Ethanol [\% (V/V)]} = \frac{\text{ethanol \% (m/m)} \times \text{SGEA}}{0{,}791}$$

where
SGEA = specific gravity of degassed beer at 20 ºC/20 ºC, to 5 decimal places
0,791 = specific gravity of ethanol at 20 ºC/20 ºC

9.1.2.4 Report the results as ethanol % (m/m) or % (V/V) to 2 decimal places.

9.2 Precision

The precision values given below [alcohol in % (V/V)] were determined from the data of collaborative trials carried out by the EBC Analysis Committee: one in November 2003 for Low and Non Alcohol Beers in which 7 to 8 laboratories analysed 5 beer samples at 5 levels and the other one in 1995/1996 for Normal Alcohol Beers in which 5 to 7 laboratories analysed 12 beer samples at 6 levels.

Range [% (V/V)]	r95 [% (V/V)]	R95 [% (V/V)]
0,007 to 0,81	0,096 m	0,068
0,84 to 7,24	0,028 + 0,07 m	0,039 + 0,021 m

where m is the mean value.

10 Bibliography

10.1 Rosendal, I. and Schmidt, F., The Alcohol Table for Beer Analysis and Polynomials for Alcohol and Extract, Journal of The Institute of Brewing, 1987, 93, 373.

10.2 Laboratory Alcohol Table, Density/Strength at 20 ºC for laboratory use, HM Custom and Excise, London, 1979.

10.3 Laboratory of the Government Chemist, 1st Draft on “Determination of Alcohol in low alcohol and alcohol free beverages”, 1994.

10.4 Institute of Brewing Methods of Analysis, 1997, Method 9.10 (Beer: Ethanol in Beverages Low in Alcohol by Gas Chromatography).

10.5 Toivola, A., Varjú, P. and Torrent, J., Journal of The Institute of Brewing, 2005, 111, 241.

ANNEX 4 - EBC 9.9.1.: TOTAL NITROGEN IN BEER: KJELDAHL METHOD[5]

Refer to Section 0 (Safety) for relevant warning and safety precautions.

1. Scope

The determination of the total nitrogen content of beer by a Kjeldahl procedure.

2. Field of Application

The method can be applied to all beers.

3. References

3.1 EBC Method 3.3.1 (Barley: Total Nitrogen of Barley: Kjeldahl Method).

3.2 International Standard, Water for analytical laboratory use – Specification and test methods, ISO 3696:1987.

4. Principle

4.1 Nitrogenous compounds in the beer are digested with hot sulphuric acid in the presence of catalysts to give ammonium sulphate.

4.2 The digest is made alkaline with sodium hydroxide solution and released ammonia is distilled into an excess of boric acid solution.

4.3 The ammonia is titrated with standard acid solution.

5. Reagents

Use the reagents as specified in EBC Method 3.3.1.

6. Apparatus

Use the apparatus as specified in EBC Method 3.3.1.

[5] Analytica-EBC, Fachverlag Hans Carl, Andernacher Str. 33a, D-90411 Nürnberg, Germany

7. Procedure

7.1 Pipette 20 ml of degassed beer into a 500 ml Kjeldahl flask.

7.2 Add 2 to 3 ml of concentrated sulphuric acid. If necessary, add antifoam to prevent excess foaming.

7.3 Gently evaporate, almost to dryness, with minima1 charring.

7.4 Add 20 ml of concentrated sulphuric acid and 10 g of catalyst; complete the digestion and distillation as described in EBC Method 3.3.1.

8. Expression of Results

8.1 Calculation

8.1.1 Calculate the concentration of total nitrogen in beer, using the formula:

$$\text{Total nitrogen (mg/litre)} = \frac{T \times 14}{V} \times 100$$

where

T = 0,1 mol/litre acid required to neutralize ammonia after subtracting the reagent blank, in ml

V = volume of sample taken, in ml

8.1.2 Express the result in mg/litre to the nearest whole number.

8.2 Precision

The precision values given below (mg/litre) were determined from the data of a collaborative trial, carried out by the EBC Analysis Committee in 1998, in which 10 laboratories analysed beer samples at 5 levels in the range 40 to 1000 mg/l.

Range (mg/l)	r_{95} (mg/l)	R_{95} (mg/l)
40 to 1000	7 + 0,012 m	10 + 0,05 m

where m is the mean value.

9. Bibliography

Bénard, M., Journal of The Institute of Brewing, 2000, 106, 135.

ANNEX 5 - EBC 9.9.2.: TOTAL NITROGEN IN BEER: DUMAS COMBUSTION METHOD6

Refer to Section 0 (Safety) for relevant warning and safety precautions.

1. Scope

The determination of the total nitrogen content of beer by the Dumas combustion method.

2. Field of Application

The method can be applied to all beers.

3. Reference

International Standard, Water for analytical laboratory use – Specification and test methods, ISO 3696:1987.

4. Principle

4.1 The sample of beer is degassed.

4.2 A sample of the beer is combusted in the presence of oxygen at about 1000 ºC to give oxides of nitrogen which are then catalytically reduced to nitrogen. Other products of combustion are removed by selective adsorption, or separated from elemental nitrogen on a chromatographic column.

4.3 The nitrogen gas is measured by a thermal conductivity detector.

4.4 The nitrogen content is calculated from the detector response. The detector is calibrated by measuring the response given by an organic compound of known nitrogen content.

4.5 Automated combustion analysers for nitrogen are available which utilise either helium or carbon dioxide as the carrier gas.

4.6 The total nitrogen content of the beer is calculated.

5. Reagents

5.1 During the analysis, unless otherwise stated, use only reagents of recognised analytical grade and water of at least grade 3 as defined in ISO 3696:1987.

5.2 Oxygen, ultra pure grade, 99,995 % purity (minimum).

5.3 Helium, nitrogen free, 99,99 % purity (minimum).

[6] Analytica-EBC, Fachverlag Hans Carl, Andernacher Str. 33a, D-90411 Nürnberg, Germany

5.4 Carbon dioxide, 99,995 % purity (minimum).

5.5 Water soluble organic calibration standard with known nitrogen content e.g. glycine.

5.6 Calibration solution. Prepare a calibration solution (0,1 % is suggested) on a % (m/m) or % (m/V) basis depending on mode of sample introduction and calculation (10.3).

6. Apparatus

6.1 Combustion Nitrogen Analyser relying on the Dumas principle and fitted with a thermal conductivity detector. The instrument must be capable of reducing NO_x compounds to nitrogen.

6.2 Analytical balance, accuracy ± 0,0005 g.

7. Preparation of Sample

7.1 Degas the beer taking care not to lose beer foam which can be rich in nitrogen.

7.2 Preconcentrate the sample, if required, following the manufacturer's recommendations.

8. Procedure

8.1 Set up the combustion analyser according to the instructions given by the instrument manufacturer. Adjust operating conditions such as gas flow rates, furnace temperature, combustion times, to ensure that the equipment is optimised. Allow sufficient time for the instrument to equilibrate.

8.2 Calibration

8.2.1 Establish the baseline of the instrument by running several reagent blanks, where required.

8.2.2 Calibrate the instrument by introducing (by weight or volume as appropriate) the calibration solution into the analyser several times.

8.3 Determination

Introduce, in accordance with the manufacturer's recommendations, an accurately measured volume or weight of sample into the analyser.

9. Expression of Results

9.1 Calculation

9.1.1 Calculation of the total nitrogen content of the beer is usually performed automatically by the data acquisition and processing system.

9.1.2 If the result is given on an (m/m) basis convert it to an (m/V) basis by multiplying with the specific gravity of the beer.

9.1.3 Express the result in mg/litre to the nearest whole number. Specify that the determination is by the Dumas method.

9.2 Precision

please insert one white line

The precision values given below (mg/litre) were determined from the data of a collaborative trial, organised jointly by the EBC and IOB Analysis Committees in 1995, in which 13 laboratories analysed 5 samples of beer in the range 362 to 1159 mg/litre. r_{95} was judged to be dependent on concentration whereas R_{95} was judged to be independent of concentration.

Range (mg/l)	r_{95} (mg/l)	R_{95} (mg/l)
362 to 1159	0,075 m	120

where m is the mean value.

10. Notes on Procedure

10.1 It is important to determine the optimum instrumental conditions for combustion ana1ysis of samples and non matrix matched calibration standards (if used). The conditions can vary and the manufacturer's recommendations must be heeded. See 10.4.

10.2 Maintenance of the analyser is important. The manufacturer's recommendations must be heeded.

10.3 Eight operational permutations result from the variations in liquid standard preparation [(m/V) or (m/m) basis], liquid sample introduction (m or v basis), and data output from instrument [(m/V) or (m/m) basis]. Care should be taken to ensure that the units reported conform to the chosen mode of operation.

10.4 It is advisable to regularly check the precision and accuracy of the instrument.

10.4.1 The precision can be assessed by running a number of successive determinations on a suitable sample. The coefficient of variation (CV) should be below 2,0 %.

10.4.2 The accuracy check must be carried out on a suitable established reference sample. Liquid calibration standards must not be used for this purpose in cases where the instrumental analysis conditions for samples and standards are not identical.

11 Bibliography

Johnson, B.A. and Johansson, C.-G., Journal of The Institute of Brewing, 1999, 105, 360.

ANNEX 6 - EBC 9.26.: TOTAL CARBOHYDRATE IN BEER BY SPECTROPHOTOMETRY[7]

Abstract

The determination of the total carbohydrate content of beer by spectrophotometry.

Refer to Section 0 (Safety) for relevant warning and safety precautions.

1. Scope

The determination of the total carbohydrate content of beer by spectrophotometry.

2. Field of Application

2.1 The method is applicable to all filtered beers. The concentration range of the test portion should be between 20 and 80 mg/litre. It is necessary to dilute the samples.

2.2 The method is highly sensitive to interference by dust and cellulose fibres. To avoid these interferences, all glassware must be cleaned with chromic/ sulphuric acid mixture before use.

3. Reference

International Standard, Water for Analytical Laboratory Use, Specification and Test Methods, ISO 3696, 1987 (E).

4. Principle

4.1 The beer is degassed and diluted with water to the required concentration of carbohydrates.

4.2 After cooling, measured amounts of beer and anthrone reagent are mixed, the mixture is heated.

4.3 After cooling, the absorbance is measured at a wavelength of 625 nm.

4.4 The concentration is calculated with the aid of the absorbance of a standard solution.

5. Reagents

5.1 During the analysis, unless otherwise stated, use water of at least grade 3 as defined in ISO 3696, 1987.

[7] Analytica-EBC, Fachverlag Hans Carl, Andernacher Str. 33a, D-90411 Nürnberg, Germany

5.2 Sulphuric acid, 85 % (V/V). Add 850 ml of sulphuric acid (d = 1,84) to water, cool to 20 °C and dilute to 1 litre with water.

5.3 Anthrone reagent. Dissolve 1,00 g anthrone in sulphuric acid 85 % (V/V) and make the volume up to 1 litre with the acid. Prepare the reagent shortly before use. Anthrone can show considerable batch to batch variation. Carefully select a suitable supply.

5.4 D-glucose standard. Dry pure anhydrous D- glucose under reduced pressure in a vacuum oven for 4 h at 100 °C and 100 mbar.

5.5 D-glucose stock solution. Weigh 0,400 g of glucose standard, dissolve in water and dilute to 1 litre in a volumetric flask with water.

5.6 D-glucose standard solution. Pipette 10,0 ml of the stock solution into a volumetric flask of 100 ml and dilute with water.

6. Apparatus

6.1 Glass stoppered test tubes, 20 mm x 150 mm

6.2 Water bath at 95 ± 0,5 °C

6.3 Spectrophotometer with 10 mm glass cells

6.4 Pipettes, 2 ml, 3 ml, 10 ml

6.5 Volumetric flasks, 100 ml, 500 ml, 1000 ml

7 Preparation of Samples

Attemperate the beer to about 20 °C. Degas the beer by transferring rapidly a number of times from one clean beaker to another. Allow foam to collapse into liquid before sampling.

8. Procedure

8.1 Test portion

Pipette 2 ml of the sample into a 500 ml volumetri flask and dilute with water.

8.2 Blank test

8.2.1 Pipette 3 ml of water into a stoppered test tube.

8.2.2 Proceed as described in the subclause “Determination”, from paragraph (8.4.2) to paragraph (8.4.6).

8.3 Calibration

8.3.1 Pipette in each of 3 stoppered test tubes 3 ml of the D-glucose standard solution.

8.3.2 Proceed as described in the subclause “Determination”, from paragraph (8.4.2) to paragraph (8.4.7).

8.4 Determination

8.4.1 Pipette 3 ml of the test portion (8.1) into a stoppered test tube.

8.4.2 Cool the tube to 2 to 4 °C.

8.4.3 Cool the anthrone reagent to 2 to 4 °C.

8.4.4 Add 10,0 ml of cooled anthrone reagent and mix thoroughly while cooling.

8.4.5 Immediately place the tube in a water bath at 95 ± 0,5 °C and leave it for exactly 20 min.

8.4.6 Cool rapidly to 20 ± 1 °C.

8.4.7 Measure the absorbance within 1 h at 625 nm in a 10 mm cell against a reference blank solution (8.2).

9. Expression of Results

9.1 Calculation

9.1.1 The total carbohydrate content of the sample, expressed in g glucose per 100 ml, is given by the formula:

$$\text{Carbohydrates} = \frac{A_s}{A_{gl}} \cdot \frac{4}{1000} \cdot \frac{500}{2} = \frac{A_s}{A_{gl}} \text{ (g/100 ml)}$$

where:

AS = Absorbance of the sample (8.4.7)

Agl = Mean absorbance of the glucose standard (8.3.2)

$\frac{4}{1000}$ = Glucose concentration of the standard, expressed in g per 100 ml

$\frac{500}{2}$ = dilution factor of the test portion (8.1)

9.1.2 Express the results to 2 decimal places.

9.2 Precision

The precision values (g/100 ml) obtained for total carbohydrate content were determined from the data of a collaborative trial carried out by the EBC Analysis Commíttee in 1996. Thirteen laboratories participated and beer samples were analyzed at six levels.

Range	r95	R95
2,3 to 4,6	0,04 + 0,02 m	-0,2 + 0,3 m

where m is the mean value.

10. Bibliography

10.1 Buckee, G.K. and Hargitt, R., Journal of the Institute of Brewing, 1977, 83, 275.

10.2 Weiner, I., Journal of the Institute of Brewing, 1978, 84, 222.

10.3 Bénard, M., Journal ofthe Institute of Brewing, 2000, 106, 135.

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