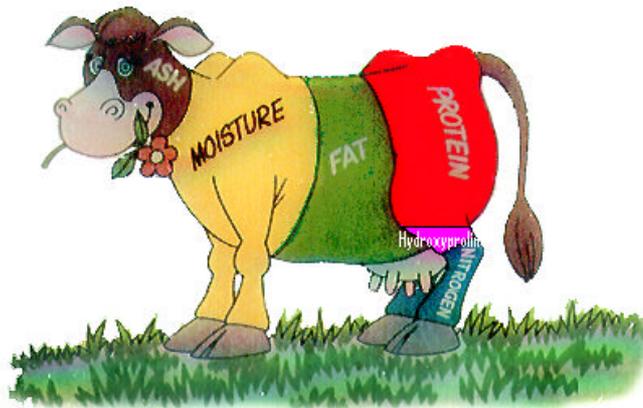# Analysing the New European Meat Definition
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Who Discusses the Draft Food Labelling Amendment (England) Regulations 2002 Implementing the New European Meat Definition and the Analytical Implications

Following the agreement of Commission Directive 2001/101 amending Directive 2000/13 on the 26th November last year, a new European meat definition sees the light of day here in England (and I'm sure very soon in Scotland, Wales and Northern Ireland). Member States were given until 1st January 2003 to bring into law these new requirements contained in the amended Directive with a transitional period until 1 July 2003 before enforcement begins. The new rules detail a generic definition of meat as skeletal muscle and, therefore, offals such as liver and kidney and MRM will no longer count as meat. In addition, there are limits for fat and connective tissue, so that for fat meat will be limited to 30% for pork, 15% for birds and rabbits and 25% for everything else, and for connective tissue, meat will be limited to 10% for birds and rabbits and 25% for everything else. This new definition is more restrictive than the current UK definition and as a result the meat declarations currently being made in ingredient lists will mostly reduce due to the lower levels of fat and connective tissue allowed to count as meat. Further, any excess fat and connective tissue will need to be declared in the appropriate place in the ingredient list.

This new meat definition will also produce some major changes in the way meat content is determined analytically. This new definition has a more scientific basis than previously and for the first time establishes maxima levels for fat and connective tissue. In the past, minimum lean meat contents have been required for the majority of meat products thus establishing restrictions on fat and amounts naturally associated with the flesh used has been specified for connective tissue. On the face of it, it would appear that analysis has been made easier because the fat and connective tissue

maxima have been laid down. Further, the connective tissue content has been stated to be the ratio between collagen content and meat protein content. The collagen content means the hydroxyproline content multiplied by a factor of 8. Where the maximum limits of fat and/or connective tissue are exceeded, the meat content must be adjusted downwards accordingly and the list of ingredients must mention in addition to the percentage "…meat", the presence of excess fat and/or connective tissue.

Before examining some of the difficulties in calculating excess fat and/or connective tissue, I think it is important to consider the history behind the determination of connective tissue. Although many have recently suggested original thinking in this area the truth is that M. Coomaraswamy undertook the original thinking. He produced a very interesting paper published in June 1972 entitled "The Calculation of Meat Content in the Presence of Excess Rind and/or Connective Tissue"[1]. In this publication he states in Table 1 that the hydroxyproline content of purified collagen is 13.4-14.4%. This would suggest a hydroxyproline X 7.2 conversion factor to collagen. He uses as support for this 3 previously published papers[2,3,4]. However, he also points out that collagen only represents about 80% of the protein in connective tissue the other protein being primarily elastin. As a result he recommends the average hydroxyproline x 100/12 = Dry fat free connective tissue protein. You will notice that this is in fact 8.33 but over time this has been rounded to 8. (As you can see this is not a precise science). This factor is not now in question as it is presented by the new regulations as 8.

Multiplying this dry connective tissue protein by 37/8 has been recommended to convert to wet fat free connective tissue. This assumes (as does the conversion of meat protein to fat free meat) an average % of protein in wet fat free connective tissue i.e. 21.6%.

Ratios: 1   2
      Collagen   x   Factor A   =   Fat Free Connective Tissue
      Meat Protein x   Factor B   =   Fat Free Meat

The European Definition of Meat defines the Collagen to Protein % is the Connective Tissue %.

This is based on two factors:

1.   The connective tissue % limits contained within the definition are calculated on the basis of the ratio between collagen content and meat protein content. Therefore, an apple-to-apple comparison is needed.

2.   The conversion of collagen to fat free connective tissue and meat protein to fat free meat require the use of appropriate factors. If these two factors are the same then the two ratios can be taken as the same. Factor A has been proposed as 4.625 (37/8). This is equivalent to 21.62% connective tissue protein being present in fat free wet connective tissue (100/4.625). For Factor A to be equal to Factor B would require 21.62% meat protein to be present in fat free meat. On average this is approximately the case. Both Factor A and B

can vary dependent on the variability of protein in fat free connective tissue and fat free meat. For all intents and purposes these two ratios are the same!

Both the Food Standards Agency in their draft guidelines[6] and CLITRAVI (Liaison Centre for the Meat Processing Industry in the EU) have suggested very similar methods in which to calculate from analytical values the declarable meat content.

This calculation is based on analytically determined levels of hydroxyproline, nitrogen and fat in each meat ingredient or combined ingredients from one species of meat. The chemical fat, hydroxyproline and protein nitrogen can be determined using ISO methods or equivalent. The following assumptions have been made and the FSA proposed calculation used:

- The values for protein, collagen and fat in the formulae below relate to the *percentage* of protein, collagen or fat in the total meat.
- Meat protein = nitrogen X 6.25
- Collagen = hydroxyproline X 8
- Step 3 below requires the use of a suitable conversion factor for the conversion of collagen into connective tissue. The generally accepted factor of 37/8 is used.

1. Calculate allowed collagen content

$$\text{Allowed collagen content (\%)} = \frac{\text{Limit for CT (\%) X (protein in meat (\%) – collagen in meat (\%))}}{(100 - \text{limit for CT\%})}$$

2. Calculate excess collagen

Excess collagen (%) = collagen in meat (%) – allowed collagen content (%)

3. Convert excess collagen into excess connective tissue

Excess connective tissue (%) = excess collagen (%) X [conversion factor]

4. Calculate allowed fat content

- **Where excess collagen > 0**

$$\text{Allowed fat content (\%)} = \frac{\text{limit for fat (\%) X (100 – excess CT – percentage of fat in total meat)}}{(100 - \text{limit for fat (\%))}}$$

- **Where excess collagen ≤ 0**

$$\text{Allowed fat content (\%)} = \frac{\text{limit for fat (\%) X (100 – percentage of fat in total meat)}}{(100 - \text{limit for fat (\%))}}$$

5.   Calculate excess fat

Excess fat (%) = percentage of fat in total meat – allowed fat content

6.   Calculate declarable meat

Declarable meat (%) = 100 – excess fat – excess connective tissue

NB – the 'declarable meat' percentage represents the percentage of the total meat on which the QUID declaration may be based.

I would like to examine this suggested method of calculation using 2 practical examples. All involve the manufacture of sausages. The following recipes relate:

Recipe 1: Pork Liver Sausage
Pork Trim 200Kg; Pork Back Fat 200Kg; Pork Liver 400Kg; Other Non- Meat Ingredients 200Kg.

Recipe 2: Pork and Beef Sausage
Pork Trim 100Kg; Pork Belly 100Kg; Beef Trim 40Kg; Pork Rind & Fat 35Kg; Pork Back Fat 45Kg; Other Non-Meat Ingredients 325Kg.

In both cases we will consider that the manufacturer analyses his ingredients and products rather than relying on typical data. In all cases he analyses for fat, meat protein and hydroxyproline (hydroxyproline x 8 = collagen).

In Recipe 1 he finds he has two ingredients, which can count in whole or part towards the meat content in accordance with the new definition i.e. pork trim and pork back fat. By mixing the two together in his bowl chopper before adding the other ingredients (assuming he wants to adopt this practice) he can take representative samples for analysis. His results tell him that on average he has a chemical fat content of 50%; a protein content of 10.8% and a collagen content of 1.94%. He also then works out his Collagen to Meat Protein %, which is 1.94/10.8 x 100 = 17.9%. He can immediately see that his fat content is above the 30% limit and he has an excess of fat to declare in his ingredients list. He will first have to work this out on his whole recipe as follows:

Allowed Fat Content (%)   = $\dfrac{30 \times (100 - 50)}{100 - 30}$ =   21.4%

Excess Fat   =   50-21.4%   =   28.6%

Excess Fat in the Recipe (%) =   28.6% x $\dfrac{400}{1000}$ =   11.44%

In the case of his connective tissue he has no concern, as 17.9% is well below the 25% limit so nothing to declare. His 'pork' declaration will need to take into account the excess fat (40% - 11.4%) = 28.6% pork. This too will need to be declared in the appropriate position in the ingredient list as a %,

In Recipe 2 he finds he has 5 ingredients that can count in whole or part towards the meat content in accordance with the new definition i.e. Pork Trim, Pork Belly, Beef Trim, Pork Rind & Fat and Pork Back Fat. He has difficulty mixing these together in his bowl chopper before adding the other ingredients, as he knows he has two limits on fat content to deal with. One for pork at 30% and one for beef at 25%. If he mixes all these together his fat analysis will not tell him what his pork and beef meat contain as fat separately. Considering the problem he also recognises that should he start using poultry meat in his recipes he will have even a worse problem. This is because the limits for poultry vary not just for fat (15%) but also for connective tissue (10%). Further if he is to use his ingredients such as Pork Trim in more than one Recipe it is much better and less costly in analysis to analyse his raw materials separately and build up a database. He can then, by ratioing his individual ingredients within his recipe come up with fat, protein and collagen levels for all his recipes.

This he does and his resultant calculations show that the Fat in his Pork Meat is 49.8%, Meat Protein is 11.7% and Collagen is 3.42%. Collagen/Meat Protein = 29.1%. For Beef his Fat is 32.5%, Meat Protein is 16% and Collagen is 4.8%. Collagen/Meat Protein is 30 %. He can immediately see that on his Pork and Beef Meat his fat content is above the 30% limit and he has an excess of pork and beef fat to declare in his ingredients list. He will first have to work this out again on his whole recipe. In the case of his connective tissue he is above the 25% limit for both pork and beef and has an excess pork and beef connective tissue to declare in his ingredient's list. He again must work this out on his whole recipe.

The following calculations relate:

Allowed Pork Collagen Content (%) $= \dfrac{25 \times (11.7-3.42)}{100-25} = 2.76\%$

Excess Pork Collagen (%) $= 3.42 - 2.76 = 0.66\%$

Excess Pork Connective Tissue $= 0.66 \times \dfrac{37}{8} = 3.05\%$

Excess Pork Connective Tissue in Recipe $= 3.05 \times \dfrac{280}{645} = 1.32\%$

Allowed Pork Fat Content (%) $= \dfrac{30 \times (100 - 3.05 - 49.8)}{(100-30)} = 20.2\%$

Excess Pork Fat (%) $= 49.8 - 20.2 = 29.6\%$

Excess Pork Fat in Recipe (%) $= 29.6 \times \dfrac{280}{645} = 12.8\%$

Declarable Pork Meat (%) $= 43.4\% - (1.32 + 12.8) = 29.3\%$

Allowed Beef Collagen Content (%) $= \dfrac{25 \times (16.0 - 4.8)}{100-25} = 3.73\%$

Excess Beef Collagen (%)   =   4.80 – 3.73% =   1.07%

Excess Beef Connective Tissue (%) = $1.07 \times \dfrac{37}{8}$ =   4.95%

Excess Beef Connective Tissue in Recipe (%) = $4.95 \times \dfrac{40}{645}$ =   0.3%

Allowed Beef Fat Content (%) = $\dfrac{25 \times (100 - 4.95 - 32.5)}{100 - 25}$ =   20.8%

Excess Beef Fat (%) =   32.5 – 20.8% =   11.7%

Excess Beef Fat in Recipe (%)   = $11.7 \times \dfrac{40}{645}$ =   0.7%

Declarable Beef Meat (%)   =   6.2 – (0.7 + 0.3)   =   5.2%

Simple and straight forward? Well let's consider some of the substantive problems involved in this approach. Some have already suggested that simply dividing, for example, the total pork fat determined analytically by the total pork meat in the recipe will not realistically tell you whether you have excess fat in the recipe. If the pork meat has excess connective tissue the true percentage fat will have to be calculated on the pork meat minus the excess connective tissue. Then you can decide whether you have excess fat in the pork.

That may be correct but what if the connective tissue has fat associated with it. Rind is a good example. Even with all of the visible fat removed rind still has 7.0 – 11.7% fat associated with it[5]. Multiplying by 37/8 works out connective tissue on a fat free basis but is that what will have to be declared as excess connective tissue in the ingredients list. The FSA draft guidelines[6] suggest that rind in the case of pork and skin in the case of chicken can be declared. However, how can you tell by analysis which connective tissue is in excess for the purpose of declaration? Is it rind in excess or the connective tissue within the meat? I know of no analytical technique to distinguish one from another. In practice, therefore, I am sure the standard conversion factor of 37/8 will be used.

What about the problems analytically of distinguishing between meat as defined by the new definition and the new non-meat ingredients? Trying to distinguish between meat and offal will bring new meaning to analysing a steak and kidney pie. If MRM or head meat (non masseter muscle) is used how again can analytical techniques distinguish between them and meat?

Associated with this is the analytical problem of determining connective tissue in a repeatable and reproducible way. Collaborative trials have demonstrated substantive problems in the past and differences between laboratories have been considerable on what was supposed to be standard mixtures. I have always suspected that a lot of these differences were due to the difficulties of getting properly homogenised standard samples. A difficult procedure when dealing with connective tissue. Recent collaborative studies, which have concentrated on improving the homogenisation of the sample so that the sample tested is truly representative of the material, would

appear to have demonstrated this is the case. This may be possible in a laboratory but it proves somewhat difficult to achieve in a formal sample scenario by a Trading Standards or Environmental Health Officer trying to do this at point of sale.
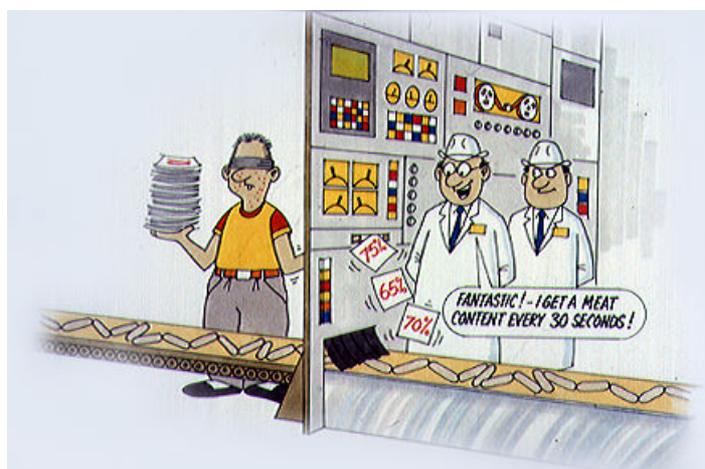
So where does this leave the analysis of meat products in the future. Well analysis will still have its place but perhaps this will be concentrated more at the mixing bowl stage in the future. What is clear is that a greater understanding of the ingredients used in a meat product will be more necessary in the future when interpreting the results of analysis on a finished product. The use of analysis alone on finished products, to prove beyond reasonable doubt a deficiency of meat content, will become far more difficult with analysis being used to hi-light a potential problem that will require further investigation. Some would say a "good thing too!" Happy meat product analysing!

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6.   Food Standards Agency Draft Guidelines on the Labelling and Declaration of Meat Content in Meat Products *(www.foodstandards.gov.uk/foodindustry/consultations/consulteng/meatproductsreg)*

Ref: ANALYSING THE EUROPEAN MEAT DEFINITION-NMG