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Meat and poultry nitrogen factors

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The determination of nitrogen as a quantitative marker for meat fat-free protein and the calculation of meat content of compound foods began almost 100 years ago. It is the established official chemical method to enforce labelling declarations of meat content in food products, and also widely used by food producers to check the specification and added water of their meat raw materials. A "nitrogen factor" is the average nitrogen content of a specific cut or whole animal on a fat free basis. The AMC has been overseeing studies to determine nitrogen factors since the 1950's, and more recent government funded studies have been made to accommodate changing rearing regimes and the genetics of the animals.

Introduction

Labelling rules[1] require that, for meat products, the species of meat used should be declared. Where ingredients are highlighted in the name of the food, the amount of that ingredient must be declared as a percentage of the final product (QUID – quantitative ingredient declaration). Products that look like a cut or piece of meat, but that have more than 5% added water, have to declare added water in the product's name as well as meat content. In addition, certain meat product names such as 'sausage', 'burger' and 'pie' are linked to minimum meat contents.[2] Although the amount of an ingredient is calculated on a recipe basis, enforcement authorities usually check the declared meat content by analysis of the finished product. The analysis determines the nitrogen content (mainly on a fat free basis) of a meat or poultry ingredient, and converts this to a meat or poultry content using a previously-determined nitrogen factor. Added water of a meat/poultry ingredient can be calculated by the difference. This approach to measuring meat content is almost 100 years old.[3] Meat product manufacturers also use nitrogen factors to check the specification of their raw materials, especially the amount of added water.

Meat animals are normally slaughtered and prepared without the use of water. However, poultry is killed and prepared by using some wet processes (de-feathering, rinsing after evisceration, cooling). The European Poultrymeat Marketing Standards Regulation (EC) 543/2008 (ref. 4) regulates the amount of extraneous water poultry and poultry parts are allowed to pick up during preparation in poultry plants without any declaration on the product label. This extraneous water has to be taken into account when poultry contents of preparations and products are determined.

Measurement of the fat-free nitrogen content of meat products is carried out according to internationally accepted methods.[5] Most laboratories in the UK use the rapid Dumas method for nitrogen determination. This measures the non-protein nitrogen as well as the protein nitrogen, and hence gives higher results than the Kjeldahl method.[6] However, for meat the difference is so small that it can be neglected. Determination of meat or poultry content requires the fat content to be measured,[7] and the full determination also involves the measurement of ash and moisture.[8,9]

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Nitrogen factors for meat and poultry

Pork

An extensive study using 60 carcases from four commercial abattoirs was published in 1991.[10] Nitrogen factors from the then average carcase weight of 70 kg were determined for the whole side of pork, and 5 other joints – leg, collar, hand, loin and belly. The factor for whole side (raw meat and inter-muscular fat) was 3.5. If the specific joint of pork used in the product is known, the factors in Table 1 can be used. It was recommended that the definition of the national average processing pig, in relation to carcass weight and fat thickness, should be assessed periodically to ascertain whether the

Table 1 Nitrogen factors for pork

Pork ingredient	Lean with intermuscular fat	Lean with intermuscular and subcutaneous fats	Lean with intermuscular and subcutaneous fats and rind
Leg (ham)	3.49	3.50	3.63
Neck (collar)	3.38	3.42	3.54
Hand	3.42	3.44	3.60
Loin (back)	3.66	3.66	3.90
Belly (streak)	3.50	3.51	3.74
Middle cuts (loin and belly)	3.58	3.58	3.82
Whole side	3.50	3.52	3.70

Table 2 Nitrogen factors for clean beef

Clean beef ingredient	Lean	Lean with intermuscular fat	Lean with intermuscular and subcutaneous fats
Brisket	3.57	3.61	3.60
Jacob's ladder	3.64	3.64	3.65
Fore rib	3.66	3.69	3.70
Chuck	3.57	3.57	3.58
Thin flank	3.68	3.73	3.73
Shin and leg	3.71	3.72	3.80
Clod and sticking	3.59	3.59	3.61
Topside	3.71	3.71	3.73
Loin, rump and fillet	3.66	3.68	3.70
Thick flank and silverside	3.64	3.64	3.66
Side	3.64	3.65	3.66
Pistola	3.67	3.68	3.70
Forequarter	3.61	3.62	3.63

nitrogen factor requires amendment. As the UK's average carcase weight in 2012 had increased to 78–80 kg, and fat levels decreased, another study estimating the factors for whole side, loin, belly, shoulder and leg was commissioned in 2013.

Table 3 Nitrogen factors for cull cow beef

Cull cow beef ingredient	Lean	Lean with intermuscular fat	Lean with intermuscular and subcutaneous fats
Brisket	3.71	3.74	3.76
Jacob's ladder	3.76	3.78	3.80
Fore rib	3.77	3.80	3.80
Chuck	3.64	3.65	3.66
Thin flank	3.73	3.77	3.80
Shin and leg	3.81	3.82	3.90
Clod and sticking	3.68	3.70	3.72
Topside	3.66	3.66	3.70
Loin, rump and fillet	3.66	3.67	3.73
Thick flank and silverside	3.62	3.61	3.66
Side	3.68	3.70	3.73
Pistola	3.66	3.67	3.72
Forequarter	3.70	3.72	3.74

Beef[11]

Nitrogen factors for beef were estimated by using a total 43 clean beef carcases and 30 cull cow carcases from six commercial abattoirs. A nitrogen factor of 3.65 (for the lean with intermuscular fat) is recommended when applied to beef generally. For clean beef and cull cow beef, factors of 3.65 and 3.70 respectively for whole sides should be used. When carcass weight and EC fatness and conformation class are known, changes in the nitrogen factors can be calculated. If there is information on individual beef ingredient joints available, then the factors in Tables 2 and 3 for clean beef and cull cow beef can be used.

Sheepmeat (mutton and lamb)[12,13]

This study took place in two parts. In the first part, nitrogen factors for mutton – whole side, hindquarter and forequarter were determined from 45 ewes. The second part examined 81 lamb carcases (3 types – milk fed, main season and hoggets) to determine nitrogen factors for whole side, forequarter, hindquarter, leg and chump. A nitrogen factor of 3.50 (for the lean with intermuscular fat) is recommended for mutton and lamb generally. When information on the use of specific joints is known, the nitrogen factors in Table 4 can be used.

Chicken[14,15]

One hundred and twenty chicken carcases (light and heavy broilers, spent hens) were dissected into breast, leg, thighs and

Table 4 Nitrogen factors for mutton and lamb

Sheepmeat ingredient	Lean	Lean and intermuscular and subcutaneous fats
Mutton forequarter	3.48	3.50
Mutton hindquarter	3.50	3.52
Mutton side	3.49	3.52
Lamb forequarter	3.50	3.53
Lamb hindquarter	3.49	3.53
Lamb side	3.49	3.53
Lamb leg and chump	3.45	3.50
Lamb loin & best end neck	3.61	3.66
Lamb scrag, shoulder, midneck & breast	3.48	3.51

Table 5 Nitrogen factors for chicken

	Lean with intermuscular fat		Lean with intermuscular fat and skin	
Chicken ingredient	Broilers	Hens	Broilers	Hens
Breast	3.75 (3.85)	3.90	3.80	3.90
Leg	3.25	3.50	3.25	3.50
Thigh	3.35	3.45	3.35	3.50
Other meat	3.35	3.45	3.30	3.50
Dark meat	3.30	3.45	3.30	3.50
Carcase	3.55	3.65	3.50	3.60

Table 6 Nitrogen factors for turkey

Turkey ingredient	Lean with intermuscular fat	Lean with intermuscular fat and skin
Breast	3.90	3.90
Drumstick	3.35	3.35
Thigh	3.35	3.40
Other meat	3.55	3.60
Dark meat	3.45	3.50
Carcase	3.65	3.65

other chicken, and analysed. Nitrogen factors of 3.50 for the skin-on carcase and 3.55 for the skinless carcase were recommended when the cut is not specified. When the cut is known the nitrogen factors in Table 5 can be used. Since 90% of the chicken used in manufactured foods is derived from broilers, when the type of chicken is not specified, the value for broilers is recommended. The most utilised part in products and catering is skinless chicken breast, and as rearing times had been reduced by around 15% by 2013, the factor for skinless chicken breast was re-examined by using 144 samples from the UK, Poland and the Netherlands. A factor of 2.75 (reduced from 2.85) was found.[15] Meat from spent hens is no longer being used in poultry products.

Turkey[16]

A total of 120 turkeys, consisting of small and medium female, and medium and large male birds from UK producers, were dissected into three main joints – breast, drumstick and thigh. A factor of 3.65 was found for the whole carcase. Where there is information on the joints used as turkey ingredients, the nitrogen factors can be found in Table 6.

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This Technical Brief was drafted for the Nitrogen Factors Sub-Committee (Chair M. Woolfe) and approved by the Analytical Methods Committee on 25/04/14.

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