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European Commission

Study of physiological water content of poultry reared in the EU

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Executive Summary

The aim of this study was to analyse the physiological water content in chicken raised and slaughtered in the European Union (EU) in 2012 and compare it to the results of a study conducted in 1993 to assess whether the limits for ‘extraneous water’ in European legislation need to be revised.

Chicken breast and leg cuts (‘samples’) were collected from March to June 2012 from seven Member States that accounted for more than 70% of EU poultry production. The samples were collected to a plan that covered the key variables of EU poultry production; breed, weight of birds (light and heavy), gender, flock and cuts. The samples were analysed by eight laboratories using methods specified in European legislation.

The results showed that the average physiological water content of chicken produced in the EU had increased slightly, whilst the average protein content had decreased slightly. If the limits for ‘extraneous water’ in European legislation were not changed then a significant number of legitimate samples (with no extraneous water) on sale in the EU would be expected to fail; about 8% of breast cuts and 13% of leg cuts would fail the limit for chicken parts that had been cooled by air chilling.

Therefore, it is recommended that the limits for ‘extraneous water’ in European legislation be amended to take into account the physiological water content of chicken produced in the EU today.

This project was funded by the European Commission and coordinated by LGC, the UK National Reference Laboratory (NRL) for added water in poultrymeat, who worked with NRLs in the Member States where chicken samples were collected and NRLs that undertook sample analysis for this project.

Introduction

Chicken, like all animal species, has water naturally present in it. This is known as the physiological water. Commercial processing in accordance with good manufacturing practice adds an amount of technically unavoidable water known as ‘extraneous water’. European legislation [1,2] sets limits for ‘extraneous water’ so that consumers are not being disadvantaged by excess ‘extraneous water’ in poultrymeat they purchase.

Factors Affecting the Physiological Water Content of Chicken Parts

Poultry production in the EU is an intensive agricultural activity. The industry is constantly striving for more efficient conversion of feed to carcass weight in the shortest possible time to give consumers value for money for poultrymeat.

The response to this requirement has been intensive breeding of chicken, and within the EU the three main broiler breeds used are Ross, Cobb and Hubbard, with Ross and Cobb predominating. Birds today are matured more rapidly than the birds used in the 1993 study [3]. Recent studies have indicated that in general, younger birds have higher physiological water contents and lower protein contents. For example, a UK study [4] in 2000 found that the protein content of chicken legs had decreased by around 2% since 1963 (the last UK study). Similarly, a study in Germany [5] revealed that the average W/P ratio of chicken legs, compared to 1993 values, had increased around 7% for chicken reared in Germany.

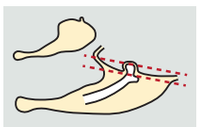
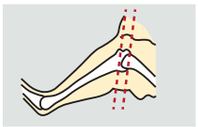
Hence the European Commission decided to re-examine W/P ratios of chicken parts across the EU to see whether they reflect changes in practices since 1993.

European Legislation

When poultrymeat is placed on the market of any European Union Member State, the descriptions used in its marketing must meet the rules and requirements set out in European Legislation [1,2]. This legislation covers:

- Quality classifications (Class A, B etc.)
- Description of cuts of poultrymeat (breast, leg, drumstick etc.)
- Permitted temperature ranges for the storage of chilled, frozen and quick-frozen poultrymeat
- Limits of technically unavoidable water uptake ('extraneous water') as a result of commercial preparation and chilling of poultrymeat.
- Claims such as "fed with X% cereal" e.g."corn-fed, or "free range" are also specified.

Examples of Some Descriptions in the Legislation

Class A and class B	Defined in terms of appearance and blemishes on whole birds and cuts	
Poultry cuts – breast, leg, drumstick, thigh etc. e.g.:	Leg- consists of femur, tibia and fibula- two cuts made at joints 	Drumstick – tibia and fibula together- two cuts made at joints 
Fresh poultrymeat	Poultrymeat not stiffened by the cooling process (i.e. freezing), and kept between -2°C and 4°C – i.e. cannot market previously frozen poultry as "fresh".	
"Free range"	Defined by stocking rate of birds, their access to open air with vegetation, and feed during rearing	

'Extraneous water'

'Extraneous water' is defined as the technically unavoidable water absorbed during the commercial preparation of poultry carcasses or cuts. European legislation [2] ensures that 'extraneous water' is kept to a minimum for good manufacturing and hygienic practice so that consumers are not being disadvantaged by excess 'extraneous water' in poultrymeat they purchase.

Water is used at several stages during the commercial preparation of poultrymeat, and is an essential part of good hygienic practice. It is estimated that during the process of removing feathers, evisceration and carcass washing, even with air-chilling, chicken carcasses absorb around 1.8% 'extraneous water'. European legislation [2] sets limits for the 'extraneous water' uptake depending on the chilling method used; the limits of 'extraneous water' for chicken cuts are:

- 2% for air chilling
- 4% for air spray chilling, and
- 6% for immersion chilling.

If the limits are exceeded, the product can only be marketed within the EU if the declaration "Water content exceeds EC limits" is on the label, and if the 'extraneous water' exceeds 5%, additional labelling of the product may also be required in accordance with the requirements of food labelling legislation.

Method for Calculating 'extraneous water'

The method for calculating 'extraneous water' is based on the premise that the water/protein (W/P) ratio is a constant number for a given species of animal or bird and their specific cuts but will change in proportion to the amount of 'extraneous water' present.

European legislation specifies that poultry cuts should be analysed in duplicate to determine the water and protein content in accordance with internationally recognised chemical methods [6,7]. W/P ratios are calculated for each sample and compared with upper limits specified in European legislation [2] for the different methods of chilling (Table 1).

Table 1. Current legislative limits - highest permissible W/P ratios

Cut	Air chilling	Air-spray chilling	Immersion chilling
Breast (skin-less)	3.40	3.40	3.40
Leg (skin-on)	4.05	4.15	4.30

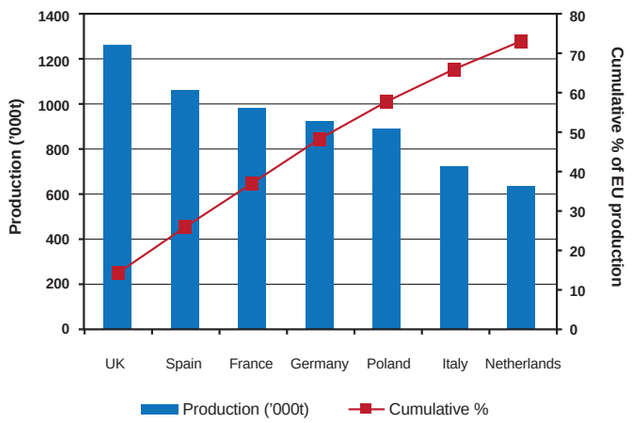
These limits were calculated from the results of the 1993 study [5] that established the physiological water content of poultrymeat produced at that time.

2012 Study

The study re-examined the W/P ratios for skinless chicken breast and skin-on chicken legs as these two cuts are the most commonly consumed in Europe.

Samples were collected from the top seven poultry producing Member States; UK, Spain, France, Germany, Poland, Italy and the Netherlands. As shown in Figure 1, these seven countries account for just over 74% of the total EU poultry production and so were considered to be representative of the EU market.

Figure 1. 2009 EU chicken (broiler) production



Data source: BPA/AVEC

Like the 1993 study:

- Two live weight ranges were sampled; light birds from 1.7-1.9 kg and heavy birds from 2.3 - 2.4 kg. However, consumers in some Member States prefer different weight ranges e.g. Italy use birds around 3.8 kg for chicken parts. Therefore weights that reflected common practice in each Member state were taken.
- An equal number of male and female birds were sampled from each breed and weight range (in six out of seven Member States)

Unlike the 1993 study:

- Two breeds of chicken were specifically sampled; Ross and Cobb, although in France, Hubbard is widely used and was sampled instead of Cobb.
- 48 birds (rather than the 20 birds in 1993) were sampled in each of seven Member States, producing a total number of 336 breast samples and 336 leg samples for analysis.

More than double the number of samples were collected in the 2012 study compared to the 1993 study, which gives increased confidence that the results obtained in this study will give a good picture of the physiological water content of the most common breeds of chicken reared in the EU in 2012.

A standardised procedure was developed so that samples were collected in as similar way as possible from each of the seven Member States. Particular emphasis was placed on the collection of the breast and leg cuts from the birds without contact with any water. This required removal of the birds from the factory line before the scald tank (used commercially to remove feathers). Breast and leg cuts were removed by hand. Figures 2 and 3 show two of the samples taken.

Figure 2. Breast fillet sample

Figure 3. Chicken leg sample

The samples were triple bagged, labelled and frozen before despatching to LGC in the UK. The samples were homogenised in accordance with the requirements of European legislation [2], repackaged and sent to seven other NRLs for analysis, so that all eight NRLs (Denmark, France, Germany, Ireland, Italy, the Netherlands, Spain and the UK) analysed an equal number of samples taken from each of the seven different poultry producing Member States. The samples were analysed for water and protein according to the procedure and methods laid down in European legislation [2].

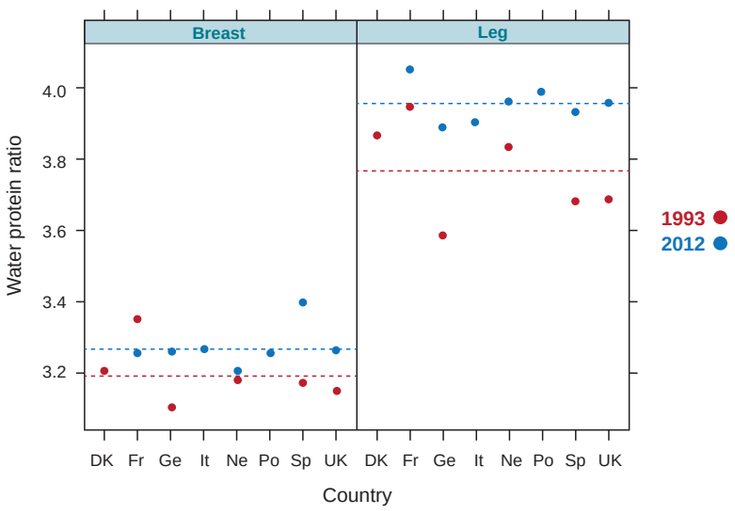
Results

All the results were analysed statistically. Although statistical differences were found between different poultry producing Member States and the gender of the birds, these differences were small compared to the spread of results and hence considered not important practically.

Comparing the 1993 and 2012 studies

Figure 4 gives the average W/P ratios obtained for the 1993 and 2012 studies.

Figure 4. W/P ratios for chicken breast and leg cuts per country



The 2012 study has confirmed that chicken produced in the EU today (younger birds than those used in the 1993 study) have slightly more water and slightly less protein when compared to the results from the 1993 study as shown in Figures 5a-d.

Figure 5a. 1993 breast

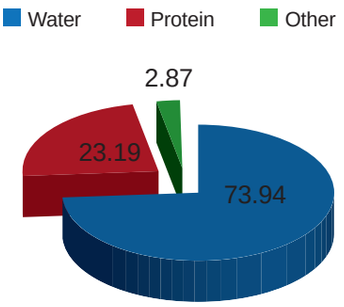


Figure 5b. 2012 breast

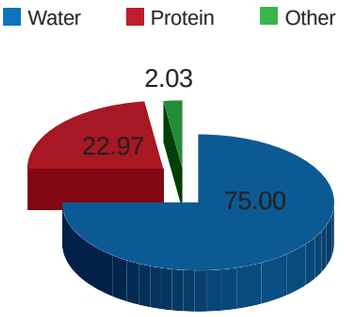


Figure 5c. 1993 leg

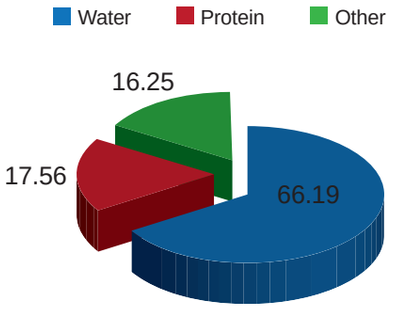
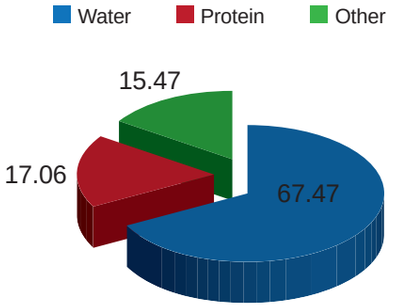


Figure 5d. 2012 leg



Outcome

Table 2 shows the highest permissible W/P ratios calculated using the 2012 results and those specified in European legislation [2], which are based on the 1993 study, for the different methods of cooling.

Table 2. Highest permissible W/P ratios from the 1993 and 2012 Studies

Cut	Breast			Leg		
Year	Air chilled	Air spray chilled	Immersion chilled	Air chilled	Air spray chilled	Immersion chilled
1993	3.40	3.40	3.40	4.05	4.15	4.30
2012	3.55	3.64	3.74	4.25	4.37	4.50

The impact of changing the limits specified in European legislation is illustrated in Figures 6a and 6b.

The figures illustrate the fraction of test samples containing no 'extraneous water' which are expected to exceed current and recalculated highest permissible W/P ratios, where:

- The curve shows the assumed normal distribution based on means and standard deviations observed for all technically valid test samples in the present study.
- The vertical line shows the relevant limit (highest permissible W/P ratios)
- The shaded region illustrates the fraction of the distribution exceeding the limit and the percentage figure shows the numerical percentage in the shaded area.
- All limits are for air-chilled meat, corresponding to 2% permitted 'extraneous water'.

Figure 6a. Breast

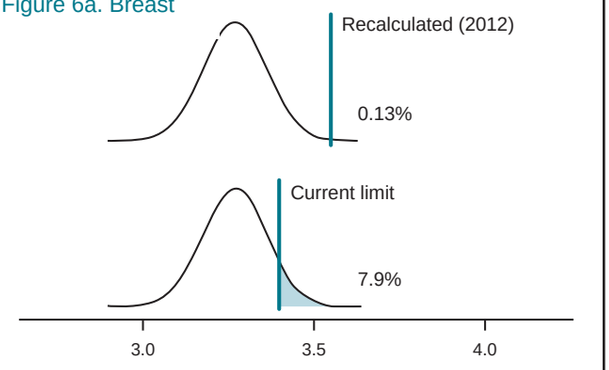
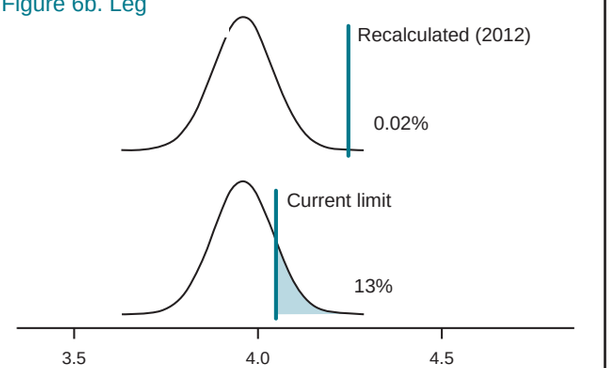


Figure 6b. Leg



Although the changes in water and protein shown in fig 5a-b appear to be small, they are significant as demonstrated in Figures 6a & 6b; if the limits specified for 'extraneous water' in European legislation [2] are not amended on the basis of the current study, then a significant number of legitimate chicken cuts (with no 'extraneous water') on sale in the EU would be expected to fail; about 8% of breast cuts and about 13% of leg cuts would fail the limits for chicken parts that had been cooled by air chilling.

This is strong evidence to support a decision to amend the limits in European legislation [2], on the basis of the current study, so that they reflect chicken reared in the EU in 2012.

Conclusion

The 2012 study has shown that the existing W/P limits in European legislation [2] for chicken breast and leg cuts are too low for chicken currently being reared in the EU. Therefore, it is recommended that the legislation should be amended to reflect the changes in water and protein contents observed in the 2012 study.

References

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2. Commission Regulation (EC) No 543/2008 of 16 June 2008 laying down detailed rules for the application of Council Regulation (EC) No 1234/2007 as regards the marketing standards for poultrymeat. OJ L157, 17.6.2008, p. 46-87.
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5. Effects of sample preparation on the water/protein ratio of poultry cuts in relation to the identification of extraneous water. MRI (Max Rubner Institute), 2009: http://www.mri.bund.de/index.php?id=858&detail_id=202961&&stichw_suche=DUMMY&zeilenzahl_zaehler=47&NextRow=10.
6. ISO 1442:1997. Meat and meat products - Determination of moisture content (Reference method).
7. ISO 937:1978. Meat and meat products - Determination of nitrogen content (Reference method).

Further Information

The full project report is available on the European Commission website:
http://ec.europa.eu/agriculture/external-studies/index_en.htm
http://circa.europa.eu/Public/irc/agri/pig/library?l=/poultry_public_domain&vm=detailed&sb=Title

For further information contact:
agri-evaluation@ec.europa.eu

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