Retained water in meat

Implications for the Australian industry

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The USDA Final Rule on retained water in carcase and carcase parts appears to require action only in the cases where water is, in fact, retained. If there is no retained water, the protocols that must be established to measure retained water and demonstrate that retained water is a result of food safety practices, do not apply. It could be inferred that if products have no retained water then no action is needed to comply with the Rule. However, the preamble indicates that foreign establishments will have to maintain a file containing data that demonstrates that the product that they ship contains no retained water although this is not mentioned in the Rule.

If individual establishments have to generate data to demonstrate that products do not retain water, it appears that this does not have to be done according to an approved protocol.

The preamble also implies that FSIS would accept data on water retention levels for multiple establishments using similar post-evisceration processing techniques. If this is the case, it may be appropriate to deal with non-water retention in a single document that applies Australia-wide rather than on an individual establishment basis.

With the exception of offals, it is very unlikely that any carcases or carcase parts from the red-meat industry would have retained water. A description of processes and some data to support this view could be collated in a single document and relieve individual establishments of the need to maintain their own data.

The practices that could lead to possible water retention are:

- Carcase washing;
- Hot boning;
- Hot water decontamination;
- Spray chilling;
- Offal washing;
- Intra-venous flushing of carcases.

Carcase washing

The preamble to the final rule notes that air chilling causes carcase weight loss from evaporation of natural water in the carcase. This should be the end of the matter as far as retained water is concerned.

The amount of water retained after carcase washing depends on the time of measurement after the wash, and weight of carcase sides. In studies by CSIRO a relationship between carcases weight and times after washing was developed (1). It is:

$$\text{Retained water} = \frac{(0.52 - 0.028 \times t) \times wt}{100} kg$$

Where t = time in minutes between washing ad reweighing and wt = weight before washing in kg.

From this relationship, the amount of retained water in a 130 kg side is:

Time between wash and re-weigh (mins)	Retained water on carcase side (%)
5	0.4
10	0.23
15	0.1
20	0

Without the effect of evaporative cooling of carcases in a chiller, any water retained from the carcase wash is likely to dissipate within 20 minutes of the wash.

Obviously, there is a huge amount of data on the difference in weight between sides before the wash and after chilling. As far as CSIRO published data is concerned, weight loss from hot-dry to cold carcases of less than 1.5% in a full chill cycle is a good result (2). Weight loss of less than 1% is virtually unknown.

There is considerable evidence to demonstrate there is a net loss of carcase weight from post evisceration to chilled carcases and the notion of water retention from carcase washing should not be an issue (2).

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Hot Boning

The question has been raised about water retention in hot-boned meat because there may be little or no evaporative weight loss from hot-boned carcases.

Establishments that transfer carcases directly from the slaughter floor to the boning room do not wash the sides and there is no possible source of retained water.

Some establishments that hot bone after a period of chilling also wash carcases. However, any water retained after washing is lost quickly. After one hour chilling there is a weight loss of 0.4% or more from the hot dry carcase (2).

There should be no need to consider whether there could be retained water on washed carcases unless the carcases were boned within a short period e.g. 30 minutes after washing.

Hot water decontamination

There are no published data on water retention following hot water decontamination. Establishments that use hot-water decontamination wash carcases before decontamination. In this circumstance there could be more water retention than occurs with washing alone. However, there can be little doubt that subsequent draining and chilling will eliminate any retained water unless the chilling period is very short

Hot water decontamination should not be considered a source of added water unless boning takes place within a short time of application of the water e.g. 1 hour.

Spray chilling

Spray chilling appears to be a target of the Rule on retained water. The process for approval of spray chilling systems in Australia already involves collection of extensive data to show that no individual carcase retains water. Any establishment that uses spray chilling, should have sufficient data to demonstrate there is no retained water in carcases.

Offal washing

Offals may retain water from washing or cooling in water. Offal washing practices are very variable and no doubt some could result in retained water. A preliminary investigation indicated that offals that were rinsed in a water spray, and then drained for about one minute before packing, retained water at the time of packing. The increase in weight from before washing to packing was:

- Cheeks – 4.6%
- Tails – 1.6%
- Hearts – 0.07%

Hearts provide an example of the difficulty of measuring retained water. The weight of heart before washing includes blood clots. There is weight loss during washing due to clots being washed out but this loss is replaced by retained water. In this case, the difference in weight before washing and the time of packing, does not equate to retained water.

It may be possible to identify offal washing and draining procedures that result in no retained water. However, it is likely that most offal washing procedures will result in retained water. It will be laborious and possibly extremely difficult to demonstrate that the retained water in offals is a necessary result of food safety interventions.

Food Science Australia could develop protocols with industry that could be used to establish the amount of retained water in offals and demonstrate that the retained water is a consequence of a food safety intervention. Individual establishments could use the protocols to generate their own data. Alternatively, it could be preferable to establish water retention in different offals using a range of washing techniques and demonstrate the food safety benefits of the washing techniques on a centralized basis. Individual establishments could use the industry-wide data perhaps with some on-plant verification of water retention figures.

Intravenous flushing of carcases

Some domestic processors are using a vascular rinsing process. They are doing so under licence agreements with MPSC Pacific Inc. There is anecdotal evidence that weight loss during chilling is reduced. To our knowledge, no export establishments have installed the vascular rinsing system.

If any of the domestic establishments with the system have plans to meet US registration requirements, water retention might be an issue.

Methods for measuring retained water

The Rule suggests that measurement of the moisture content of meat samples could be used to determine if the sample contains retained water. The moisture content of a sample depends on factors other than added water. For example the pH and fat content will affect water content. A 1% variation in fat content results in approximately 1% variation in moisture content. Thus, moisture content of any offal type is bound to be variable. Some published figures for the moisture content of offals are:

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Offal	Moisture content (Source of data)	
Beef tongue	69.0% (3)	64.5% (4)
Veal tongue	64.8% (3)	74.5% (4)
Beef heart	74.1% (3)	75.5% (4)
Tail	64.8% (3)	68.6% (4)

In view of the variation in moisture content of specific offals, it is unlikely that a measurement of moisture content could be used to establish if there is retained water in an offal. As an example, if 85 C.L. cheekmeat retains 5 % water after washing, this would increase the water content from 67 % to about 68.5%. This is about the same increase in moisture content that could be expected from a 2% reduction in C.L.

Measurement of moisture content alone will not give a reliable indication of retained water. The effect of fat on moisture content could be allowed for by specifying expected moisture content of offals at different fat contents and by measuring both the moisture and fat content of samples to judge retained water. Alternatively, moisture and protein in samples could be measured and retained water judged from the moisture:protein ratio.

Measurement of moisture content could give an indication of retained water if changes in moisture content of individual offals are measured before and after a washing process. However, determination of whether or not there is retained water during processing can be estimated from weight changes. In most cases this would be the simplest and most reliable method of determining retained water by the processing establishment. There may be some cases where water retention is masked by weight losses e.g. removal of blood clots from hearts during washing.

Tests to estimate retained water in packed offals must be based either on the moisture content of a sample expressed on a fat-free basis or on moisture:protein ratio basis. Moisture content measurement alone is not sufficient to determine water retention.

The preferred method of determining water retention at meat packing establishments is to measure weight difference between pre-water application and packing.

Drip and weep

The appearance of drip or weep is not an indicator of retained water. Weep from chilled meat is a result of changes in water holding capacity of proteins during post-mortem changes in muscle physiology and changes that occur during ageing. Large amounts of weep can be attributed to chilling, boning and handling practices and bear no relation to retained water.

Drip from thawed meat is affected by the freezing rate and thawing rate. Meat that is frozen with retained water will produce excessive drip but excess drip is not an indicator of retained water.

Published data have not been reviewed at this stage. It is expected that there is sufficient published data to demonstrate that there is too much variability in drip and weep caused by normal practices to make it unreasonable to attribute drip or weep to a single cause such as retained water.

References

(1) B.P Cain, (1980). The effect of washing on beef carcase weight. CSIRO Meat Research Report 6/80.

(2) L.S. Herbert, J. Anderson, and W.S. Larnach, (1977). Carcases chilling in Australian Abattoirs. CSIRO Meat Research Laboratory, July 1977.

(3) W.F. Spooncer, (1992). By-product yields from sheep and cattle. CSIRO Meat Research Report 2/92.

(4) B.A. Anderson, (1988). Composition and nutritional value of edible meat by-products. In: "Edible Meat By-products, Advances in Meat Research vol. 5" A.M. Pearson and T.R. Dutson, eds. Elsevier Science Publishers.

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