Rabbit meat quality assessment in Quebec

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Introduction: In 2012, Canada had fewer pig and cattle farms, than the USA, but they had, on average, more animals per farm (USDA, 2014; AAFC, 2018a). Likewise, for rabbit production, Canadian farms were twice as big as it was in the USA (AAFC, 2018b). For the same year, Ontario and Quebec produced 50.60 and 38.31% of the Canadian rabbit production with 36.57 and 7.1% of rabbit farms, respectively (AAFC, 2018b). Since 2011, rabbit production is relatively stable in Quebec, partly because it is considered a speciality product or a festive meat. In 2014, consumption was relatively low with 0.0254 kg per person in Canada (AAFC, 2018b) and 0.040 kg per person in Quebec (MAPAQ, 2015). From 2010 to 2014, rabbit meat consumption, has increased up to 3% per year in Quebec, whereas the consumption of beef and pork has decreased by 1.3 and 1.7% per year, respectively (MAPAQ, 2015).

Quebec rabbit producers are highly involved in the development of their production and demonstrated leadership on the recent development of the national Code of Practice for the Care and Handling of Rabbits released in 2018. Furthermore, even with no research center or specialized expertise in rabbit production in Canada, six research projects have been realized from 2009 to 2014 (MAPAQ, 2015). Thereafter, investments and new initiatives were made to valorize this agricultural activity and to conquer more consumers.

Even if rabbit production is still a marginal agri-food activity in Quebec, and in Canada in general, it contributes to the diversity of the food offer and its development can only be achieved if our farmers produce quality meat. One of the main factors influencing microbial meat quality is preslaughter management (fasting, transport and lairage time), which is well defined in many other species, like poultry and pork. Unfortunately, rabbit preslaughter management is not well defined and fasting time as high as 24 h has been imposed on producers even if the limited current literature recommends 15 h (Bianchi et al., 2008). In the first hours of fasting, live weight decrease is ascribed to the stomach weight reduction, but, a prolonged fasting can cause rabbit corporal tissues to lose nutrients and humidity, which can lead to loss of quality and yield (Bianchi et al., 2008). The aim of this study was to assess meat quality from rabbits commercially raised in Quebec.

Material and Methods: For the assessment of rabbit meat quality produced in the province of Quebec, five rabbit producers were selected, in collaboration with the *Syndicat des producteurs de lapin du Québec* (SPLQ), and their preslaughter management was noted. Rabbits from three producers were slaughtered in Flinton, Ontario, in a facility under federal inspection. Rabbits from the other two were slaughtered in two facilities under provincial inspection located in Saint-Henri and Saint-Alphonse-de-Granby, Quebec.

For each group slaughtered in Quebec, full stomach was weighted promptly after slaughter. The pH of the *Longissimus lumborum* (LL) and the *Biceps femoris* (BF) muscles were measured *post-mortem* after 24 h (pH_u; ultimate pH) using a portable pH meter (ThermoFisher, Nepean, ON, Canada) combined with an Orion Kniphe pH electrode (ThermoFisher, Nepean, ON, Canada) and

a temperature compensation probe (928 007 MD, micro probes ATC, Maryland, USA) on 25 carcasses. The drip loss was measured on a piece of LL (2 cm thick x 2.5 cm in diameter) by weight difference using the EZ-Drip loss method (Rasmussen et Andersson, 1996) where samples are stored at 4 °C for 48 h. For each group slaughtered in Flinton, the same quality measurements were performed 24 hours *post-mortem* upon arrival at the refrigerated warehouse (Laval cold storage Ltd, Quebec) on 25 carcasses as well.

Results and discussion: Each producer had a different preslaughter management (table 1) which depends on where the rabbits were slaughtered, in Quebec (short transport, provincially inspected) or in Ontario (long transport, federally inspected).

Table 1 Preslaughter management according to producers and season.

		Season	Transport time (h)	Total fasting time[1] (h)
Provincial 1[2]	**Producer P1-A**	Winter	2.25	15.5
	Producer P1-B	Winter	0.17	8.5
	Producer P1-A2[3]	Summer	2.25	13.5
Provincial 2[2]	**Producer P2-A3[3]**	Summer	2.55	16
Federal[2]	**Producer F-C**	Winter	5	29
	Producer F-D	Winter	5	26.5
	Producer F-E	Summer	6.75	23

[1]Total fasting time includes fasting time at farm, transport and lairage time.
[2] Indicate the slaughterhouse jurisdiction in which rabbits were slaughtered. The Provincial 1 (P1) was in Saint-Henri and P2 in St-Alphonse de Granby (Quebec), whereas the federal (F) ones were in Flinton (Ontario) for three different producers (C, D and E).
[3] Producers A2 and A3 are the same as A, but with a different preslaughter management.

As expected, stomach weigh decreased as the fasting time increased ($P < 0.0001$) raging from 138.1 g after 8.5 h to 86.5 g after 16 h (Fig 1). Reducing stomach volume is important to prevent the release and spread of microbial contamination at evisceration (Faucitano et al., 2006). A greater reduction is to be expected with a longer fasting time since stomach weight did not reach a plateau even after 16 h of fasting (Fig 1).

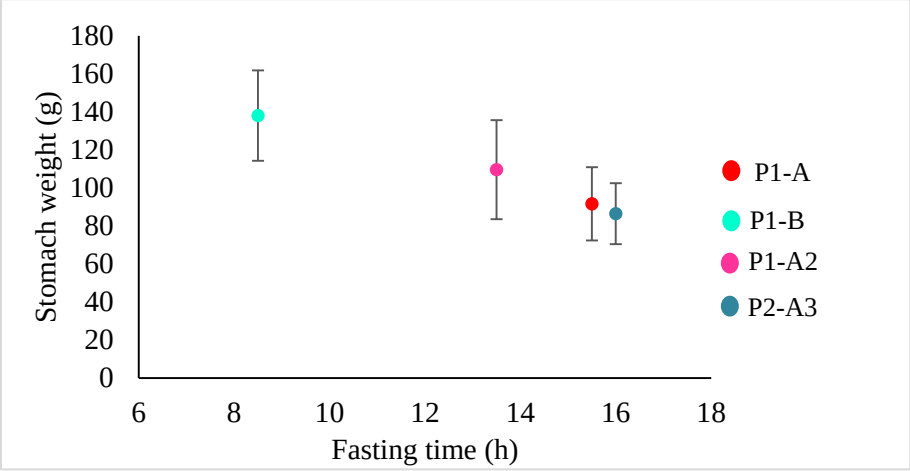

FIGURE 1 Rabbit stomach weight variation according to fasting time when slaughtered at a provincially inspected abattoir.

An ultimate pH of 6 is known to be the threshold pH value for dark, firm and dry (DFD) meat and is considered unsuitable as it favours microbial growth (Hulot & Ouhayoun, 1999; Faucitano et al., 2010). However, BF pH_u tends to be higher than LL pH_u (≈6 vs 5.7-5.8; Cullere & Dalle Zotte, 2018) and so, a pH_u <6 for the BF is more difficult to achieve. The ultimate pH of the LL was above 6 for P2-A3, F-C and F-D and for every producer except P1-B for the BF (Fig 2). The high pH_u of the producer P2-A3 rabbits is suspected to be due to a potential cold shortening effect. During meat quality assessment, some carcass temperatures were near 0 °C.

Producer F-E has a different preslaughter management than the other producers who sent their rabbits to Ontario. Lights were open around 4 A.M. and crating began around midday. But, unlike the others, the feeders were never removed before crating, which allowed subordinate rabbits to eat. Rabbits rather eat during the night than during the day thus dominant animals are the firsts to feed and they will not let their subordinates eat at the same time. So, by letting the feeders accessible, all rabbits can have minimal muscle storage before the transport to the slaughterhouse. This resulted in an ultimate muscular pH <6 even if those rabbits had to undergo a long transport time. Part of the long fasting period is associated with the fact that the transporter discharged the animals not on the morning of the slaughter day, but by the end of the day before slaughter.

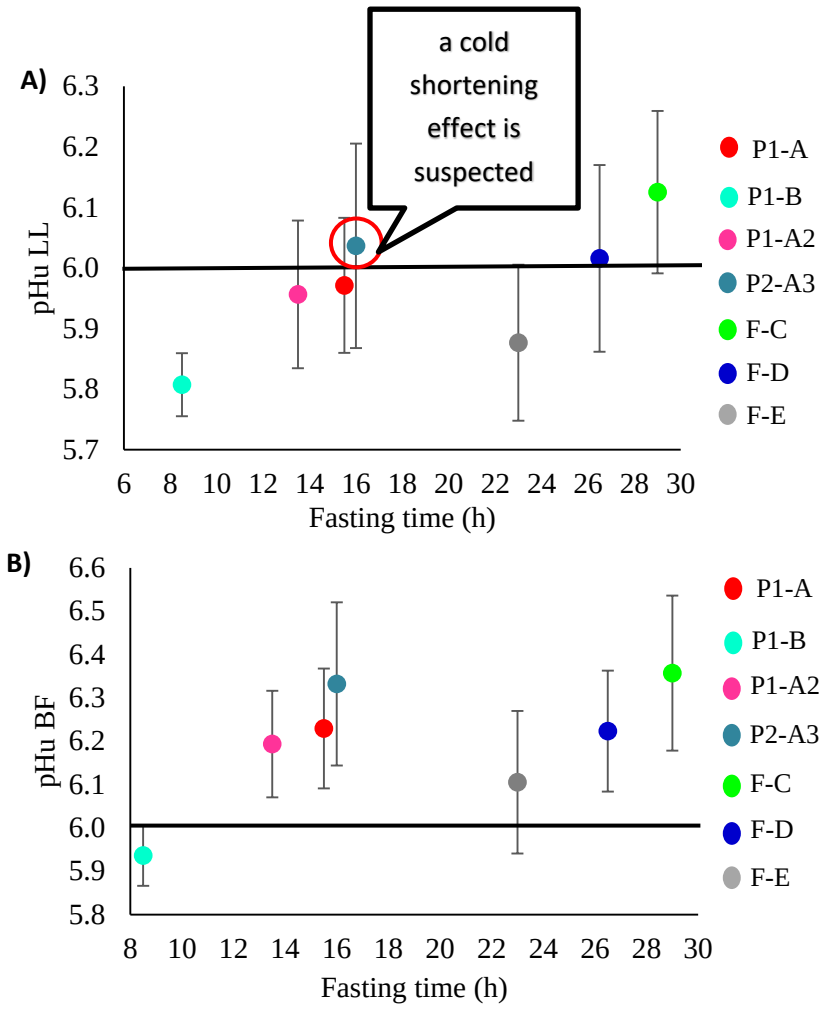

FIGURE 2 *Longissimus lumborum* (LL; A) and *Biceps femoris* (BF; B) ultimate pH according to fasting time.

The relation between the drip loss and the pH_u is well known (Hulot & Ouhayoun, 1999). With a high pH_u, meat has a high water-holding capacity and, therefore, a low drip loss. Ideally, drip loss must be low in order to obtain a juicy meat. But when combined with a pH_u >6, it can lead to DFD meat. As such, a meat with a low drip loss and a pH_u <6 is ideal. Producers P1-B, P1-A2 and F-E have a good preslaughter management in order to achieve this goal (Fig 3).

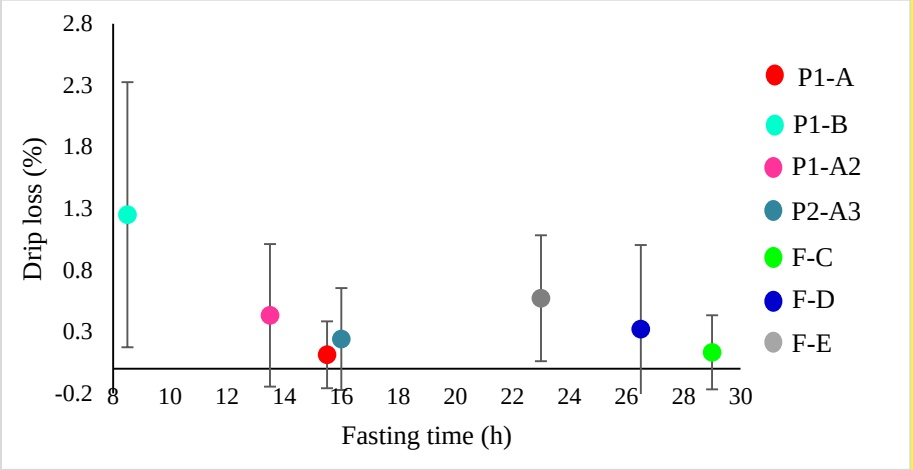

FIGURE 3 Rabbit meat drip loss according to fasting time.

Conclusion: Our results indicate that, if the transport to the slaughterhouse is short, a total fasting time around 14–16 h should be appropriate in order to obtain a good quality meat with a small stomach weight. If a long transport is required, it is also possible to have a good quality meat, but the preslaughter management must be different. In fact, limited on-farm fasting, like with producer F-E, could help limiting the depletion of muscle reserves during transport.

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