Meat Science 231 (2026) 109953

Contents lists available at ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

Swiss beef meat tenderness improvement in the period 2009–2023☆

Paolo Silacci [a,*], Blaise Perrey [b], Christophe Joye [c], Jonas Inderbitzin [c], Sylvain Lerch [d]

[a] Animal Biology, Agroscope, 1725 Posieux, Switzerland
[b] Proviande, Brunnhofweg 37, 3007 Bern, Switzerland
[c] Post-Harvest Quality of Plant Products, Agroscope, 3003 Bern, Switzerland
[d] Ruminant Nutrition and Emissions, Agroscope, 1725 Posieux, Switzerland

ARTICLE INFO

Keywords:
Beef tenderness
Warner Bratzler shear force
Sensorial analysis
Swiss market

ABSTRACT

This study reports results from monitoring the time trend of beef meat tenderness in the Swiss market to address consumer satisfaction and quality optimization. The survey, conducted through four campaigns performed from 2009 to 2023, evaluated the instrumental and sensory characteristics of beef tenderness. Sirloin, tenderloin, rump, and rump cover samples were collected from various Swiss cities and analyzed for shear force values and sensory attributes. The results highlight the overall good quality of beef and a marked improvement in meat tenderness throughout the study period, with the percentage of tender samples increasing from 77.7 % (2009) to 90.7 % (2023). Multiple factors may have contributed to maintain this high quality, including a long aging time. These findings support the Swiss beef industry's efforts to maintain high-quality standards and enhance consumer trust.

1. Introduction

Over the past few decades, the beef production sector has experienced a significant influence by societal expectations to improve animal welfare and reduce greenhouse gas emissions. The introduction of novel plant-based and laboratory-produced foods, considered meat substitutes, presents an additional challenge to the long-term economic sustainability of the meat industry (Chriki et al., 2022). Such trends necessitate ensuring high and stable beef quality to foster consumer trust and satisfaction. Assessing the intrinsic quality of meat is complex, encompassing technological, nutritional, and sensory characteristics. Flavor and tenderness are the most crucial characteristic of consumer satisfaction (Liu et al., 2020; O'Quinn et al., 2018). Several physical parameters, categorized as intrinsic (e.g., muscle fiber types and quantity, intramuscular fat, and collagen content) and extrinsic (e.g., slaughter procedure, carcass handling, duration, and conditions of meat aging), influence meat tenderness (Clinquart et al., 2022). Similar to the National Beef Tenderness Survey (NBTS) conducted in the United States (Gonzalez et al., 2024), Agroscope has implemented a regular survey evaluating the tenderness of beef sold in the Swiss marketplace since 2009 (Dufey, Dougoud, & Silacci, 2017). The survey, named Obstend (Observatoire de la tendreté), has conducted four campaigns so far (2009, 2014, 2018, and 2023). Initially focused on instrumental tenderness, the panel of analysis was further expanded to include an evaluation of nutritional value. In 2018, Proviande—the Swiss institution representing the beef production sector—introduced a DNA-based origin control program for beef sold in Switzerland to safeguard the Swiss-origin meat label (www.proviande.ch/fr/le-controle-de-lorigine). Correlation of probe analysis with the traceability program automatically yielded a unique identification number allowing to access several information on the origin animal, including slaughter date (and consequently exact meat aging duration, provided the meat remained unfrozen), the sex, age, and likely breed of the source animal. Finally, in the latest campaign, the analysis panel was further expanded to include sensory analysis, focusing on three major characteristics: tenderness, juiciness, and overall flavor. The campaigns prioritized four meat cuts of Swiss origin. The primary aim of these surveys is to contribute to the production of high-quality beef in Switzerland and to enable the early detection of emerging issues. This article examines the changes in beef tenderness during the four Obstend campaigns.

☆ This article is part of a Special issue entitled: 'MEATCON 2025' published in Meat Science.

* Corresponding author.
E-mail address: paolo.silacci@agroscope.admin.ch (P. Silacci).

https://doi.org/10.1016/j.meatsci.2025.109953
Received 28 May 2025; Received in revised form 2 September 2025; Accepted 5 September 2025
Available online 8 September 2025

2. Materials and methods

2.1. Sample collection

Sirloin (*Longissimus thoracis*), tenderloin (*Psoas major*), rump (*Gluteus medius*), and rump cover (*Gluteobiceps*) meat samples were collected from three butcheries in each of the 13 Swiss cities (Basel, Bern, Chur, Delémont, Fribourg, replaced since 2018 by Schaffausen, Geneva, Lausanne, Lucerne, Lugano, Neuchâtel, Sion, St.Gall and Zurich) chosen to fairly represent Swiss territory, between October and January of the indicated years. All surveys incorporated both artisanal and supermarket butcher's counters, maintaining an equilibrium between the two. Only fresh, unfrozen meat was requested at purchase. All samples (a total of 117 in 2009, 116 in 2014, 123 in 2018, and 116 in 2023; see Table 1 for details) were obtained from retail outlets and were not prepackaged. Meat was assumed to be vacuum-stored at 4 °C until purchase, if other specific storage processes were not mentioned, which was the case of only two probes in 2009. After purchase, the samples were immediately transported to the laboratory at 4 °C. There, two-centimeter-thick slices were prepared, weighed, and vacuum-sealed before being frozen at −20 °C for two months prior to further analysis. To ensure compliance with Proviande's Swiss beef traceability program, only meat declared to be of Swiss origin was bought from 2018 onward.

2.2. Meat tenderness analysis

For each survey, meat samples were randomly assigned to 10 cooking batches (an average of 12 samples per batch) to measure the Warner–Bratzler shear force (WBSF). The steaks were thawed at 4 °C overnight, weighed, and further cooked to a core temperature of 65 °C ± 2 °C on a plate grill SH/GR 3500 Indu-Griddle plate grill (Hugentobler, Schönbühl, Switzerland). Sirloin steaks averaged 183 g (± 4 g), tenderloin 98 g (± 16 g), rump 110 g (± 43 g), and rump cover 143 g (± 37 g). Ten cores, each measuring 1.27 cm in diameter, were taken from each steak to measure WBSF perpendicular to the direction of muscle fibers, using a TA.HDplus texture analyzer (Stable MicroSystems, Godalming, England) with a 50 kg load cell, as previously described (Chambaz et al., 2003; Reiche et al., 2019). In the 2023 campaign only, 17 trained panelists who provided informed consent assessed the tenderness, juiciness, and flavor of the meat samples over 13 separate sessions. After cooking, the steaks were cut into samples of similar dimensions and served for tasting. Probes dimension was the same for each meat cut. Each panelist worked in a private cabin, rating samples on a 0 (lowest grade) to 10 (highest grade) scale (Reiche et al., 2019; Silacci et al., 2025).

2.3. DNA-based origin control program

In the origin control program, muscle tissue samples of virtually all bovine carcasses processed in Switzerland underwent immediate freezing and shipment to MSD Animal Health GmbH (Schlieren, Switzerland). Moreover, between 3500 and 4000 beef samples per year were collected from the Swiss market and sent to MSD Animal Health GmbH; the samples used in the present study for the last two campaigns (2019 and 2023) were included in this program. Subsequently, the samples underwent genotypic analysis via the DNA Traceback® platform, enabling identification of the animal origin of each steak via a unique identification number (BDTA number: "Bestimmung der Tierhaltung und Aufzucht"). This procedure yielded several key data points, namely the animal's age, breed, and hot carcass weight, as well as the slaughter date and meat aging duration.

Table 1
Percentage and frequency (in brackets) of availability of each cut in butcheries.

Year	Sirloin	Tenderloin	Rump	Rump cover
2009	87.2 (34)	84.6 (33)	79.5 (31)	48.7 (19)
2014	87.2 (34)	87.2 (34)	87.2 (34)	35.9 (14)
2018	94.9 (37)	87.2 (34)	84.6 (33)	48.7 (19)
2023	84.6 (33)	79.5 (31)	84.6 (33)	48.7 (19)

The actual number of samples collected per year (of 39 expected) for each meat cut is given in brackets.

2.4. Statistical analyses

WBSF data were analyzed using NCSS 2022 Statistical Software (NCSS LLC., Kaysville, UT, USA) and a linear mixed-effects model. Fixed factors included year and butchery effects, while random factors included butchery, city (nested within butchery), and cooking batch effects. Sensory results were analyzed with the same model in R (4.4.1) using meat cut as a fixed factor and panelist, session, and butchery as random factors, as previously described (Silacci et al., 2025). Tukey–Kramer tests were used to analyze the differences in least square means between the groups. We considered the differences to be significant at $P \leq 0.05$ and reported a tendency toward significance as $0.05 < P \leq 0.10$.

3. Results

The years 2009 and 2014 demonstrated a predominance of males (56 % and 70 %, respectively), while female representation exceeded that of males in 2018 and 2023 (55 % in both instances). Data collected by the traceability program shows a shift in meat production from 2018 to 2023, showing an increase in the contribution of crossbred animals from 39 % to 46 %. There was no observable predominance of any breed. In the years 2018 and 2023, the proportion of animals slaughtered before reaching 24 months of age was 83 % and 87 %, respectively. In all campaigns, most butcheries provided sirloin, tenderloin, and rump (observed recovery rates varied from 79.5 to 94.9 %), while rump cover availability was always below 50 % (Table 1). The implementation of Proviande's Swiss beef traceability program enabled the precise determination of the interval between slaughter and purchase. The data show exceptionally long mean aging times (31 d in 2018 and 36 d in 2023), and only for tenderloin did the aging time significantly increase, from 26 ± 3 d in 2018 to 39 ± 4 d in 2023. The other meat cut groups did not exhibit significant differences in aging time. Table 2 shows that, across all meat cuts analyzed, with the exception of sirloin, instrumental tenderness significantly improved over successive surveys. A comparative analysis of 2009 and 2023 values revealed a decrease in WBSF values of 15.4 % for tenderloin, 21.7 % for rump, and 26.4 % for rump cover. The frequency of beef cuts categorized as tender, based on pre-established consumer satisfaction metrics (Dufey, Silacci, et al., 2017), progressively increased across successive surveys for all cuts, with the exception of the tenderloin in 2014 (Table 3). In 2023, 100 % of sirloin and rump cover samples were categorized as tender (Table 3). No differences were observed in thawing losses regardless of meat cut of year (data not shown). No statistically significant correlation between WBSF and aging time emerged from the correlation analysis of the 2018 and 2023 survey data, whether analyzed individually or jointly (data not shown). Sensory analysis of meat cuts, introduced in 2023, revealed that tenderloin exhibited superior tenderness compared to both the sirloin and rump, with rump cover showing intermediate tenderness ($P < 0.001$). Rump cover exhibited superior juiciness compared to all other meat cuts ($P < 0.05$), whereas the sirloin exhibited a less intense flavor profile ($P < 0.001$; Table 4). A statistically significant correlation ($r = -0.32$, $P < 0.05$) emerged in 2023 between WBSF and sensory tenderness (Table 5).

4. Discussion

The initial 2009 Obstend survey assessed Swiss beef tenderness,

Table 2
Evolution of WBSF values (N) across the different Obstend surveys.

	Year				SEM	*P*-Value		
Beef cut	2009	2014	2018	2023		Y	B	Y * B
Sirloin	26.2	24.9	24.0	23.5	0.81	0.101	0.194	0.957
Tenderloin	34.4[a]	30.5[b]	31.8[a,b]	29.1[b]	1.16	0.020	0.257	0.794
Rump	30.9[a]	28.8[a,b]	26.2[b,c]	24.2[c]	1.08	<0.001	0.291	0.779
Rump cover	33.4[a]	27.6[a,b]	25.5[b]	24.6[b]	1.13	<0.001	0.469	0.142

Least square means, SEM and effects are reported. Within a line, different superscripts indicate that differences between means are statistically significant ($P \leq 0.05$). Abbreviations: Y = year; B = butchery.

Table 3
Percentage of each meat cut allocated according to tenderness category along the different Obstend surveys.

	Year	Sirloin	Tenderloin	Rump	Rump cover
Tough (≥ 38.3 N)	2009	2.7	19.4	9.1	19.0
	2014	0.0	5.6	5.6	6.3
	2018	0.0	17.6	3.0	0.0
	2023	0.0	3.2	0.0	0.0
Intermediate (32.4–38.3 N)	2009	18.9	58.3	39.4	52.4
	2014	11.1	33.3	22.2	12.5
	2018	2.7	50.0	12.1	5.3
	2023	0.0	25.8	12.1	0.0
Tender (≤ 32.4 N)	2009	78.4	22.2	51.5	28.6
	2014	88.9	61.1	72.2	81.3
	2018	97.3	32.4	84.8	94.7
	2023	100.0	71.0	87.9	100.0

Tenderness categories are reported accordingly to a consumer satisfaction metrics previously described (Dufey, Silacci, et al., 2017).

Table 4
Sensory characteristics of the different meat cuts of the 2023 Obstend survey.

	Sirloin	Tenderloin	Rump	Rump cover	SEM	*P*-Value
Tenderness	6.2[b]	6.9[a]	5.8[b]	6.2[a,b]	0.30	<0,001
Juiciness	4.7[b]	4.8[b]	4.7[b]	5.5[a]	0.27	0,011
Flavor	5.4[b]	6.4[a]	6.3[a]	6.5[a]	0.20	<0,001

Least square means, standard error of means (SEM), and effects are reported. Within a line, different superscripts indicate that differences between means are statistically significant ($P \leq 0.05$). Tenderness, juiciness, and flavor were judged on a 0 (lowest grade) to 10 (highest grade) scale by 17 trained panelists and results were previously reported (Silacci et al., 2025).

Table 5
Correlation index (pearson-method) between WBSF and sensory characteristics.

	WBSF	95 % CI	*P*-Value
Tenderness	−0.32	−0.47; −0.14	0.009
Juiciness	−0.08	−0.26; 0.10	>0.999
Flavor	0.11	−0.07; 0.29	0.999

A statistical analysis of 2023 data, showing correlation indices and their 95 % confidence intervals (CI) between WBSF values and sensory beef attributes. Correlations were statistically significant at $P \leq 0.05$.

providing a detailed market overview, facilitating the detection of raising issues potentially affecting meat tenderness, and enhancing consumer transparency. Subsequently, three additional campaigns were undertaken, and the panel of recorded quality traits was progressively expanded. Across the four surveys, the results showed that the shear force values recorded for tenderloin were consistently higher than those of the other beef cuts. We observed higher values of shear force, presumably because of a heat shortening of the *Psoas major* muscle fibers, which starts within the first hour postmortem due to the electrical stimulation applied during hide removal, a practice commonly used in Swiss slaughterhouses (Dufey, Dougoud, & Silacci, 2017). Implementing sensory analysis in the fourth campaign provided contrasting results compared to WBSF data. A negative correlation (−0.32) was observed between sensory tenderness values and WBSF. The observed negative correlation is in agreement with prior research, which has indicated correlations between WBSF and consumer sensory tenderness ratings that varied from −0.39 to −0.72 (Caine et al., 2003; Destefanis et al., 2008; Martinez et al., 2023). However, tenderloin was judged the most tender cut of meat by the sensory panel, whereas its instrumental tenderness showed less favorable values (Silacci et al., 2025). Several factors may explain the difference between instrumental and sensory measures of tenderness for tenderloin. First, shear forces act perpendicular to muscle fibers at points of maximal resistance; by contrast, consumers assess overall tenderness through multidirectional mastication. Second, employing meat samples with high overall tenderness in the sensory analysis may have confounded the correlation between the sensory and instrumental data. With the exception of sirloin, whose instrumental tenderness has remained excellent across all available Obstend monitoring results (Table 3), a progressive improvement in instrumental tenderness was noted across all meat cuts. Rump cover showed the most significant reduction in WBSF values, specifically between 2009 and 2014, and the most substantial rise in the percentage of tender samples, increasing from 29 % in 2009 to 100 % in 2023. Despite showing superior tenderness and juiciness, as assessed by the 2023 survey's sensory analysis, the availability of rump cover is still limited to less than half of the butcher shops studied. The data from Obstend surveys may be helpful in improving the market prospects for this meat cut. The sensory evaluation conducted during the 2023 campaign highlights the relevance of tenderness, juiciness, and flavor in determining consumer appreciation of beef. These findings are in agreement with recent work by Liu et al. (2020), who demonstrated that, for European consumers, flavor is the primary driver of overall liking (accounting for 39 % of the variance), followed by tenderness (31 %) and juiciness (24 %) (Liu et al., 2020). This shift likely reflects a general improvement in tenderness over recent decades, making flavor a more discriminating trait in consumer perception. This further underscores the importance of simultaneously considering all three sensory traits to better predict consumer satisfaction—particularly when aiming to promote underutilized cuts such as rump cover, which performed well in sensory evaluations.

Despite the long aging time observed, no statistically significant correlation between WBSF and aging time could be observed. The findings were consistent across all datasets, including global, meat cut-specific, and year-specific data (data not shown). This finding is consistent with previous research indicating that the most substantial reductions in shear force occur within the first 14–21 days of aging, with limited additional improvement thereafter (Colle et al., 2016; Joo et al., 2023). Furthermore, the imprecise determination of aging duration in the initial survey campaigns (2009 and 2014), which showed the most significant tenderness improvement, hinders adequate evaluation of this correlation. Further factors, namely the animal's sex and age, and the quantity of intramuscular fat, known to influence meat tenderness, would require careful consideration (Clinquart et al., 2022). However, the currently available data is not extensive enough to verify how these factors impacted the survey results.

In the last two campaigns of the survey (2018 and 2023), meat aging times were impressively high, with average values approaching or even exceeding 30 d for all the meat cuts and with an increasing percentage of meat samples exhibiting aging periods exceeding 56 d. The percentage of samples exceeding Proviande's established threshold for frozen retail meat (personal communication) rose from 3 % in 2018 to 14 % in 2023. Freeze-thaw cycles present a considerable threat to beef meat quality due to the development of large ice crystals, which damage cell structure and release pro-oxidant elements, thus accelerating lipid and protein oxidation. This process ultimately degrades the meat's sensory and nutritional properties. (Rahman et al., 2014). Regarding microbiological safety, freeze-thawing can cause sub-lethal harm to pathogens, which could lead to recovery and multiplication during thawing when optimal conditions are present (Johler & Guldimann, 2024). To ensure food safety, complete transparency to the consumer is required in the sale of previously frozen and thawed meat. The increasing number of samples that may have undergone freezing and thawing presents a significant challenge for the future in ensuring consumer confidence. For future campaigns of the Obstend survey, the set of analyses may be further extended by implementing a method for differentiating fresh and frozen-thawed meat.

5. Conclusion

The Obstend survey has provided valuable insights to the evolution of tenderness of beef at retail in Switzerland over the period 2009–2023. The findings demonstrate a significant improvement in meat tenderness over time, which is crucial for consumer satisfaction. The implementation of the DNA-based origin control program has enhanced the precision of meat quality assessments, especially for determining meat aging duration. These efforts contribute to the Swiss beef industry's ability to maintain high standards and foster consumer trust. Continued monitoring and analysis are essential to addressing emerging challenges and ensuring the ongoing production of high-quality beef.

CRediT authorship contribution statement

Paolo Silacci: Writing – original draft, Validation, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Blaise Perrey:** Writing – review & editing, Validation, Project administration, Conceptualization. **Christophe Joye:** Writing – review & editing, Validation, Methodology, Conceptualization. **Jonas Inderbitzin:** Writing – review & editing, Validation, Investigation, Conceptualization. **Sylvain Lerch:** Writing – review & editing, Supervision, Methodology, Data curation, Conceptualization.

Funding

This work was supported by Agroscope and Proviande.

Declaration of competing interest

The authors have no conflicts of interest to declare.

Acknowledgments

The authors would like to thank the staff of Proviande and of the Animal Biology research group of Agroscope (Posieux, Switzerland) for excellent technical support.

Data availability

Data will be made available on request.

References

Caine, W. R., Aalhus, J. L., Best, D. R., Dugan, M. E., & Jeremiah, L. E. (2003). Relationship of texture profile analysis and Warner-Bratzler shear force with sensory characteristics of beef rib steaks. *Meat Science, 64*(4), 333–339. https://doi.org/10.1016/S0309-1740(02)00110-9

Chambaz, A., Scheeder, M. R. L., Kreuzer, M., & Dufey, P.-A. (2003). Meat quality of Angus, Simmental, Charolais and Limousin steers compared at the same intramuscular fat content. *Meat Science, 63*(4), 491–500. https://doi.org/10.1016/S0309-1740(02)00109-2

Chriki, S., Ellies-Oury, M. P., & Hocquette, J. F. (2022). Is "cultured meat" a viable alternative to slaughtering animals and a good comprise between animal welfare and human expectations? *Animal Frontiers, 12*(1), 35–42. https://doi.org/10.1093/af/vfac002

Clinquart, A., Ellies-Oury, M. P., Hocquette, J. F., Guillier, L., Sante-Lhoutellier, V., & Prache, S. (2022). Review: On-farm and processing factors affecting bovine carcass and meat quality. *Animal, 16*(Suppl. 1), Article 100426. https://doi.org/10.1016/j.animal.2021.100426

Colle, M. J., Richard, R. P., Killinger, K. M., Bohlscheid, J. C., Gray, A. R., Loucks, W. I., … Doumit, M. E. (2016). Influence of extended aging on beef quality characteristics and sensory perception of steaks from the biceps femoris and semimembranosus. *Meat Science, 119*, 110–117. https://doi.org/10.1016/j.meatsci.2016.04.028

Destefanis, G., Brugiapaglia, A., Barge, M. T., & Dal Molin, E. (2008). Relationship between beef consumer tenderness perception and Warner-Bratzler shear force. *Meat Science, 78*(3), 153–156. https://doi.org/10.1016/j.meatsci.2007.05.031

Dufey, P. A., Dougoud, B., & Silacci, P. (2017). Surveys on the tenderness of Swiss beef: 2009 and 2014 [article]. *Recherche Agronomique Suisse, 8*(7–8), 260–267.

Dufey, P. A., Silacci, P., Dougoud, B., Biolley, C., & Messadene, J. (2017). Validation of the standards used for the instrumental measurement of beef tenderness [article]. *Recherche Agronomique Suisse, 8*(7–8), 268–275.

Gonzalez, A. A., Williams, E. P., Schwartz, T. E., Arnold, A. N., Griffin, D. B., Miller, R. K., … Savell, J. W. (2024). National Beef Tenderness Survey—2022: Consumer sensory panel evaluations and Warner-Bratzler shear force of beef steaks from retail and foodservice. *Meat and Muscle Biology, 8*(1), 16911–16991. https://doi.org/10.22175/mmb.16997, 16997.

Johler, S., & Guldimann, C. (2024). An introduction to current trends in meat microbiology and hygiene. *Current Clinical Microbiology Reports, 11*(4), 259–263. https://doi.org/10.1007/s40588-021-00175-7

Joo, S. T., Lee, E. Y., Son, Y. M., Hossain, M. J., Kim, C. J., Kim, S. H., & Hwang, Y. H. (2023). Aging mechanism for improving the tenderness and taste characteristics of meat. *Journal of Animal Science and Technology, 65*(6), 1151–1168. https://doi.org/10.5187/jast.2023.e110

Liu, J., Ellies-Oury, M. P., Chriki, S., Legrand, I., Pogorzelski, G., Wierzbicki, J., … Hocquette, J. F. (2020). Contributions of tenderness, juiciness and flavor liking to overall liking of beef in Europe. *Meat Science, 168*, Article 108190. https://doi.org/10.1016/j.meatsci.2020.108190

Martinez, H. A., Miller, R. K., Kerth, C., & Wasser, B. E. (2023). Prediction of beef tenderness and juiciness using consumer and descriptive sensory attributes. *Meat Science, 205*, Article 109292. https://doi.org/10.1016/j.meatsci.2023.109292

O'Quinn, T. G., Legako, J. F., Brooks, J. C., & Miller, M. F. (2018). Evaluation of the contribution of tenderness, juiciness, and flavor to the overall consumer beef eating experience. *Translational Animal Science, 2*(1), 26–36. https://doi.org/10.1093/tas/txx008

Rahman, M. H., Hossain, M. M., Rahman, S. M., Hashem, M. A., & Oh, D. H. (2014). Effect of repeated freeze-thaw cycles on beef quality and safety. *Korean Journal for Food Science of Animal Resources, 34*(4), 482–495. https://doi.org/10.5851/kosfa.2014.34.4.482

Reiche, A. M., Oberson, J. L., Silacci, P., Messadene-Chelali, J., Hess, H. D., Dohme-Meier, F., … Terlouw, E. M. C. (2019). Pre-slaughter stress and horn status influence physiology and meat quality of young bulls. *Meat Science, 158*, Article 107892. https://doi.org/10.1016/j.meatsci.2019.107892

Silacci, P., Joye, C., Dubois, S., Inderbitzin, J., Perrey, B., & Lerch, S. (2025). Quality of Swiss beef confirmed by 2023 survey. *Recherche Agronomique Suisse, 16*, 1–7. https://doi.org/10.34776/afs16-1