La revue scientifique
Viandes & Produits Carnés
Référence de l'article : VPC-2018-34-2-4
Date de publication : 09 mai 2018
www.viandesetproduitscarnes.com

Meat science toward 2030 : merci de donner votre avis

Merci de participer à cette enquête internationale ouverte à toutes et à tous pour préciser l'agenda de recherches en sciences des viandes à l'horizon 2030

Mots-clés : Enquête, Viande, Recherche

Auteur : Rod Polkinghorne[1], David W. Pethick[2]

[1] Birkenwood International Pty Ltd, 45 Church St, Hawthorn, Vic 3122, Australia ; [2] Murdoch University, Murdoch, Australia,

* E-mail de l'auteur correspondant : rod.polkinghorne@gmail.com

Vous êtes invités à participer à une enquête internationale organisée par « Birkenwood International Pty Ltd » pour contribuer à définir l'agenda de recherches en sciences des viandes à l'horizon 2030 https://docs.google.com/forms/d/e/1FAIpQLSf4b30-TP1Ftr6x99JFuR7t7fpAnYxv4hCvgLvyQMy-kHZDmA/viewform.

Résumé :
« Birkenwood International Pty Ltd » vous propose de contribuer à l'agenda international de recherches en sciences des viandes.
PHASE 1. Nous vous invitons à soumettre votre point de vue en répondant aux deux questions suivantes:
1) Quels sont les principaux défis et opportunités pour la recherche scientifique sur les viandes vers 2030 ?
2) Comment pouvons-nous exploiter les progrès scientifiques et les connaissances ainsi acquises sur la viande dans le futur ?
Veuillez soumettre vos réponses en ligne sur: Meat Science Towards 2030 (https://docs.google.com/forms/d/e/1FAIpQLSf4b30-TP1Ftr6x99JFuR7t7fpAnYxv4hCvgLvyQMy-kHZDmA/viewform). Nous acceptons les réponses jusqu'au 20 juin 2018.
PHASE 2. Examen de toutes les soumissions. Les soumissions éclaireront la mise en place d'un groupe d'experts internationaux sur les sciences de la viande. Des discussions de haut niveau auront lieu au sein de ce groupe lors de la phase 3.
PHASE 3. Convocation du Groupe d'experts mondiaux sur les sciences de la viande pour une réunion de deux jours (lieu à préciser).
Les membres du groupe d'experts en science de la viande recevront un financement pour leur temps personnel et leurs déplacements. On souhaite que les résultats de cette réunion se traduisent par un accord sur des stratégies ambitieuses qui répondront aux défis identifiés et aux opportunités pour 2030. Ces accords incluront potentiellement des stratégies pour encourager une approche collaborative au niveau mondial et le développement de l'expertise scientifique couplés à une accélération du transfert de connaissances grâce à une meilleure interaction entre la filière viande et la recherche.

Abstract: Meat science toward 2030: global strategic directions initiative background paper
Birkenwood International Pty Ltd is inviting you to contribute to the international research agenda in meat sciences.
PHASE 1. We invite you to submit your views in response to the following questions:
1) What are the key challenges and opportunities for meat science toward 2030?
2) How do we harness meat science and related expertise into the future?
Please submit online at: Meat Science Toward 2030 (https://docs.google.com/forms/d/e/1FAIpQLSf4b30-TP1Ftr6x99JFuR7t7fpAnYxv4hCvgLvyQMy-kHZDmA/viewform). We welcome responses until June 20th, 2018.
PHASE 2. Review of all submissions. The submissions will inform the setting up of a Global Meat Science Expert Group and high level discussions within this group when convened in Phase 3.
PHASE 3. Convening of the Global Meat Science Expert Group for a 2-day meeting (location to be advised).
Members of the Meat Science Expert Group will receive funding towards personal time spent and travel. It is anticipated that the outcomes of this meeting will include agreement on high-level strategies that address the identified challenges and opportunities out to 2030. These will include potential strategic approaches to encourage collaborative application of global resources and development of research talent together with an acceleration of knowledge transfer through enhanced industry and research interaction.

INTRODUCTION

The viability of the Red meat industry is intrinsically linked to the understanding and application of Meat Science. The Australian industry has high operating costs by global benchmarks. It is therefore imperative for the industry to create additional value through ongoing innovation in product and process to deliver consumer value.

The challenges are considerable (Ledward and Hopkins, 2017; Scollan *et al.,* 2011), but exciting, and must be embraced with vigour to deliver an improved and sustainable future. The biological foundation of the product dictates that Meat Science is fundamental to the process and provides the Meat Science community the challenge to deliver the necessary knowledge for Industry to innovate.

Over time, there have been a number of transformative technologies, underpinned by meat science and engineering application (reviewed by Troy and Kerry, 2010), that have fundamentally changed the red meat industry.

These have included: refrigeration with the associated ability to ship product with extended shelf life over long distances creating global trade between the UK, South America and Australia; standardised carcase and cut description systems arising from market changes to enable remote trading of product unseen by the buyer and underpinned by audit and certification systems; vacuum packaging which facilitated distribution and export of chilled meat and trading of individual cuts, often to different markets from the one carcase and leading increasingly to combined slaughter and boning establishments supplying cuts to butchers rather than carcasses. (Case ready packaging systems may be viewed as a more recent development driving significant change in centralised packing and distribution arrangements).

What are the next transformative technologies and science required to enable application and adoption? Which exist now but are at the early adoption stage requiring meat science and commercial input to realise their potential?

What are the blue sky opportunities yet to be fully articulated?

The Australian Meat Processor Corporation (AMPC) has instigated and participated in major strategic planning activities to develop a clear strategic vision to ensure a sustainable industry and address identified threats. These encompass whole of industry collaboration and AMPC specific studies. These include the Australian Meat Industry Strategic Plan MISP 2020: http://rmac.com.au/wp-content/uploads/2016/12/MISP-2020-doc.pdf.

From these reports, critical areas identified for Meat Science related actions include enhanced consumer understanding and interaction to provide improved value, improved supply chain collaboration, active development of a strategic innovation culture and global partnerships.

Your views and insights are sought and valued in gaining a broad perspective on where challenges and opportunity may lie and in formulating a coordinated and collaborative strategy. By taking a global view, the project aims to obtain diverse views arising from a wide range of local situations, to understand what has worked, what hasn't and why and to develop a structure that facilitates collaboration and mutual red meat industry advancement.

To stimulate discussion some background and identified issues that affect the Australian red meat industry are briefly outlined below. We encourage your input not to be restricted to these issues as new insights (both challenges and opportunities) or alternative positions are welcome.

I. CONSUMER RELATIONSHIPS AND PRODUCT VALUE

As the sole source of industry revenue, the ultimate consumer is of critical importance. The industry must understand the consumer in both local and global contexts, address issues of concern and provide a high value product that effectively competes with far lower cost competitive protein sources. Health and diet, declining consumption in developed countries, the percentage of beef and lamb consumption growth in developing markets and community interest in animal welfare and environmental issues have been identified as areas of significance (reviewed by Pethick *et al.,* 2011 and Scollan *et al.,* 2011).

I.1. Health and Wellbeing

The positioning of red meat as a preferred component in a healthy diet is a core issue (reviewed by Cashman and Hayes, 2017). While not new, it follows several decades of consistent industry attack from advocates who promote reducing or eliminating red meat consumption. Only recently has the wisdom of animal fats being a major dietary hazard been challenged successfully. What research is required to provide evidence of red meat health benefits? Where are the priority areas? Which negative issues are legitimate and may be addressed by research? Are there structures that can facilitate international collaboration in both research and dissemination of outcomes?

I.2. Animal Welfare

Community expectations are legitimately high for animal welfare standards (Botreau *et al.,* 2009). Industry recognises the relationship between a social licence to operate and animal welfare standards but there are also broader benefits in increased profitability through animal temperament and stress relationships to production efficiency, animal and human safety and, potentially, eating quality. Where can Meat Science improve welfare outcomes, community perceptions and profitability through improved performance? What practical stress indicators can be developed for on farm and abattoir use? Can FLIR, retinal scanning or other technologies improve management?

I.3. Improved and simplified product description

The expected result from most consumer goods is clear. However, the red meat consumer is often confronted with a confusing array of terms, cut names and claims from which they are expected to estimate a cooked meal outcome.

The AMPC strategic plan and MISP findings recognise that pricing pressures may put new product development and innovation at risk. Responses listed to mitigate price sensitivity include significant product differentiation through different grades of eating quality, packaging, product branding and service.

Most industry grading and description systems apply a common description to a carcase as a whole (reviewed by Polkinghorne and Thompson, 2010). These typically describe appearance (butt shape, muscle score, fat depth), sex, weight and age/maturity/dentition. Post slaughter descriptions based on observation of the loin surface at the quartering point include marbling, meat and fat colour and pH. The observed data is often utilised to create quality and yield grades applied at carcase level. None of these measures provide effective or simple description of a meal which is the critical consumer need.

The Australian Meat Standards Australia (MSA) system has further developed the use of carcase based inputs to create individual muscle eating quality estimates utilising untrained consumer evaluation as the primary measure (reviewed by Bonny *et al.,* 2018). A change toward consumer based quality description of individual meal portions is seen by many as a fundamental driver of industry change. Further background reading is provided in the Australian Industry White Paper (www.ampc.com.au/uploads/Market/Aust-Beef-Language-White- Paper.pdf). What further research approaches may be useful to improve the ability to accurately estimate consumer satisfaction levels and enable related description and pricing systems? What technical developments may facilitate objective estimates?

II. TECHNOLOGICAL DEVELOPMENTS

The AMPC strategic plan (reviewed by Biddle *et al.,* 2016) acknowledges that the Australian industry operates under higher cost structures than competitors due to labour rates and regulatory imposts. To be internationally competitive, it must aggressively innovate to justify higher pricing through superior product, and to must be implemented in concert with sound Meat Science imperatives to ensure product integrity is maintained. How should Meat Science, Engineering and Software disciplines be coordinated to encourage integration and facilitate practical commercial application?

Current areas of technological development initiatives are briefly discussed below as done previously for pigs (reviewed by Kristensen *et al.,* 2014).

II.1. Improved accuracy of carcase & muscle yield estimation & measurement

Traditional yield descriptors such as butt shape, external fat point measures, sex and dentition have known serious limitations. More sophisticated estimates as used in USDA and Japanese yield grades and in EUROP classification are superior but still only moderate in accuracy across populations. Individual cut identification and actual weight also offers a solution but requires technology that can operate at sufficient throughput.

Application of technology offers scope for substantial improvement with CT scanning regarded as the gold standard. DEXA has a current measure of acceptance in lamb processing and is at early evaluation stage for beef (reviewed by Gardner *et al.,* 2018). Vision systems have been adopted for yield measures in some countries with RGBD camera technologies also being evaluated in live animal and carcase applications. What other technologies are on the horizon? How can meat science support development and application? How do we integrate engineers and software developers with Meat Science to optimise industry efficiency and consumer product value?

II.2. Man versus machine

Evaluation systems are rapidly evolving with increased sophistication in many instances associated with greater affordability where broader technologies such as those used in smartphones can be adapted for industry use. Further sophisticated technologies and robotics utilised in medicine, security, military and other areas may potentially be adapted for meat industry use. Camera and image analysis systems are currently in use for some traits such as marbling and rib fat depth and are promising greater potential as are a range of tools relying on spectra including NIR, Hyperspectral and Ramon (reviewed by Troy *et al.,* 2016). How do meat scientist's best engage and collaborate with the engineers? Are there smarter ways to interact with medical or other research developments?

II.3. Processing developments to improve yield, shelf life and eating quality

Processing systems can significantly impact yield, shelf life and eating quality with stunning, bleeding, carcase suspension, chilling, packaging and ageing all being critical and often inter-related. Chilling regimes vary widely including the use of spray chilling and various combinations of temperature, time, air flow and velocity. Research recommendations have differed in defining chill time (for example 10 hrs at 10 degrees followed by deep chilling or, at the other extreme very fast chilling) and in defining a temperature and pH relationship irrespective of time. Previous research work has speculated on systems that may hot bone and differentially chill primals with more recent but limited application of other technologies to stretch, shape or prevent muscle shortening. Which technologies have the most potential? What research gaps exist to fully understand the mechanisms? What "blue sky" approaches are on the horizon?

III. SUPPLY CHAIN INTEGRATION AND COLLABORATION

Improved supply chain integration is seen as an essential basis for industry sustainability and reduced price fluctuation. In contrast to red meat sectors, competing poultry and pig industries are characterised by vertical integration with commensurate communication, research and production linkage driving continuous improvement across production sectors. Direct consumer value signals being transferred throughout the supply chain is recognised as a pre-requisite to increase productivity and driver of improved performance (reviewed by Bonny *et al.*, 2018).

III.1. Value assessment and communication in trading systems

Accurate value based trading systems across the supply chain offer the potential to transform industry efficiency (reviewed by Polkinghorne and Thompson, 2010). When accurately measured highly significant differences arise from both yield and quality variation across the carcase, both of which are poorly measured, reported and priced under most current systems. While the industry trades on averages, the value range in cattle and carcase groups is masked. Current advances and research effort are aimed at providing the ability to accurately reflect value at each transaction point and to provide a genuine reflection of final consumer value from retail counter or restaurant menu to the value adding, processing, finishing, backgrounding and breeding segments. It can be argued that the continual long term productivity gains in industries such as dairy, pig and poultry reflect the accuracy of measurement and direct pricing linkage to products or components. What is needed from the meat science community to facilitate understanding of value drivers, accuracy and methodology of calculation and the cultural change that may be needed? Do meat scientists have a role in championing systemic change? What are the research needs to assist the process?

III.2. Genomics application throughout the supply chain

The AMPC strategic plan clearly identifies that farm suppliers must be profitable to ensure a sustainable industry. Overall industry profitability and stability is related to supply chain integration or collaboration. The processor role in providing accurate price signals and data to enable and encourage on farm adaption of genetic and management strategies for mutual benefit is acknowledged with funding encouraged for research that encompasses multiple supply chain sectors.

As the potential of any animal is set at conception, and reduced by subsequent actions, it is self-evident that genetics have an important interaction with meat science (reviewed by Berry *et al.*, 2017). Rapid and continuing advances in genomics have accelerated progress in the dairy industry across the globe, aided by pooling of genetic and production data through Interbull and collaborative analysis. The meat industry is yet to achieve the same rate of adoption but can clearly benefit greatly from similar application toward yield and quality (reviewed by Picard *et al.*, 2015). Data to date however is concentrated on the *longissimus* muscle and principally on shear force or other laboratory measures. Furthermore, improving animal and meat phenotyping is crucial to make the best of genomics (Barendse, 2011). What research is required to maximise the genomics opportunity and speed up application and adoption? Are there better mechanisms to encourage greater interaction between meat scientists and geneticists?

III.3. Live animal measures and management tools

Alternative breed, feed and management interactions have been studied for decades in relation to livestock performance and carcase based outcomes. What needs to be revisited in the light of new technologies and more recent research? What areas hold the greatest promise to encourage improved production of nutritious, delicious, affordable beef? Which technologies offer promise to accurately predict carcase composition or quality prior to kill? Can measures of temperament be used to reduce dark cutting by identifying individuals at risk and applying remediation on farm or in lairage?

Dramatic change in communication technologies is also facilitating extensive data exchange (reviewed by Hocquette *et al.*, 2012) with potential to integrate producer and processor data for mutual benefit both through brand values relying on individual animal history and in adopting breeding and management systems to reflect value based payment and veterinary feedback from the processor.

The area of data exchange is of critical interest to AMPC and Meat & Livestock Australia (MLA) with recognition of the need to implement systems that facilitate uniform data collection and analysis techniques (reviewed by Biddle *et al.*, 2016 and Pethick *et al.*, 2018) allied to commercial applications that can effectively manage and interpret “big data”. How can complex megadata output from alternative technologies be interpreted for practical industry use? How do meat scientists interact in the development and utilisation of these technologies?

IV. FUNDAMENTAL BIOLOGY: PURE RESEARCH KNOWLEDGE DEVELOPMENT

Effective and efficient commercial application of meat science is fundamentally based on pure research that explains and quantifies the complex biology that explains “how things work” with emphasis on all aspects of the production of meat. Biological interactions critically impact the live animal and subsequent carcase biology is directly reflected in eating quality outcomes, muscle differences, ageing potential, cooking method interactions and consumer satisfaction. The live animal, carcase and consumer interactions need to be understood to mitigate and control the risk of benefits in one component relating to negative impacts in another.

The basic understanding of muscle biology is being continually expanded over time (reviewed by Hocquette *et al.*, 2014). Meat tenderness has long been studied but is there more to do? Flavour appears far less understood and more difficult to interpret than tenderness and may deserve more attention. The final eating experience clearly involves all facets and the combination of tenderness, juiciness and

flavour with the development of each attribute both linked and resulting from myriad interactions and including connective tissue, protein components, enzymes and fat contributions in combination with pH and temperature conditions. Where is our basic science limiting? What is a sensible mix of pure and applied research? How can communication be improved to ensure effective collaboration between researchers and industry? What is required to engage young scientists and ensure future expertise?

V. TRAINING AND DEVELOPMENT OF THE NEXT GENERATION

Highly developed skills are required to successfully operate in any business as complex as red meat and a new generation of leaders, industry professional managers and production staff must be trained, nurtured and developed to leave all industry segments in capable hands with solid growth prospects in a very competitive environment. New approaches will be required to foster the development of an open innovation network and requisite attitudes and competence. More than ever before interpersonal, inter - company and international R&D and extension relationships will be required to develop, deliver and optimise opportunities created by accelerated innovation. How can the industry build interest in a meat industry career and attract the best and brightest? How can a seamless multilevel system that accommodates basic practical skill training to high end science be facilitated and nurtured?

AMPC envisages transitioning from R&D and enterprises facilitation to developing and leading an industry culture change (reviewed by Troy and Kerry, 2010) toward operating within thought leader resource networks to an open innovation network. This involves harnessing the world's best ideas and leading practices in the process of building enduring industry relationships and a growing dynamic network of service providers.

VI. RESEARCH COLLABORATION WITHIN A COMPETITIVE ENVIRONMENT

Under current funding models, most research is funded by competitive grant. By nature, this engages institutions and individuals in a competitive rather than collaborative framework and may not always deliver the best or most efficient solution with reducing funding increasing the pressure. Further, private funding models and concentration on IP ownership can limit accessibility to the broader industry. Concurrently, however, decreasing resources might be more efficiently utilised by specialisation and collaboration between centres of excellence (reviewed by Hocquette *et al.*, 2012). A related problem is ensuring the legacy of experienced researchers is not lost but passed on and that the brightest and best young scientists are nurtured to ensure continuity and viable future meat science capacity by attracting and retaining the best. What are appropriate principles to optimise research outcomes? How can local and international collaboration be best encouraged?

VII. BRIDGING THE GAP BETWEEN SCIENCE AND INDUSTRY ADOPTION

Traditionally in the red meat industry, there has been a significant time lag between research initiation, conclusions and industry adoption (reviewed by Troy and Kerry, 2010). Part of this may reflect communication issues or the lack of clear commercial benefit from adopting new findings. What are/have been the impediments to rapid research adoption? What structural research arrangements can improve adoption? Is there a process that can better facilitate a smooth linkage from pure science to applied science to commercial application?

VII. CONCLUSIONS

Based on the challenges discussed above, an initiative has been taken by the Australian Meat Processor Corporation (AMPC) to frame a global strategy for future research funding. AMPC invests over $35million each year in red meat processor levies into research, development and extension programs that improve the sustainability and efficiency of the sector.

AMPC recognises that the viability of the red meat industry is intrinsically linked to meat science and has engaged Birkenwood International Pty Ltd to seek a global consensus view on research priorities for the next decade to optimise opportunities and outcomes from meat science research by:

- •identifying strategic research streams to 2030
- •fostering development of young meat scientists, and
- •facilitating a new research model linking global expertise within collaborative research projects

This initiative presents internationally renowned meat scientists and young scientists with an invitation to address two questions: 1) What are the key challenges and opportunities for Meat Science over the next decade and 2) How do we harness Meat Science and related expertise into the future.

References:

Barendse W. (2011). The effect of measurement error of phenotypes on genome wide association studies. BMC Genomics 12, 232.

Berry D.P., Conroy S., Pabiou T., Cromie A.R. (2017). Animal breeding strategies can improve meat quality attributes within entire populations. Meat Science, 132, 6–18.

Biddle R., Pattinson R., Philpott J., Polkinghorne R., Thompson J., Troja P, Williams, S. (2016) Australian Beef Language White paper. A paper submitted to Meat and Livestock Australia, Sydney, NSW, Australia.

Bonny S.P.F., Hocquette J.-F., Pethick D.W., Legrand I., Wierzbicki J., Allen P., Farmer L.J., Polkinghorne R.J., Gardner G.E. (2018). Review: The variability of the eating quality of beef can be reduced by predicting consumer satisfaction. Animal, in press. doi:10.1017/S1751731118000605

Botreau R., Veissier I., Perny P. (2009). Overall assessment of animal welfare: Strategy adopted in Welfare Quality. Animal Welfare 18(Sp. Iss. SI):363–370.

Cashman K.D., Hayes A. (2017). Red meat's role in addressing 'nutrients of public health concern'. Meat Science, 132, 196-203.

Gardner G.E., Jose C.G., Calnan H.B., Stewart S.M., Pethick D.W., McGilchrist P., Brown D.J., Pitchford W.S., Ruberg C., Marimuthu J. (2018). Accelerating the development of carcase measurement technologies in Australia. EAAP Annual Meeting 2018, Dubrovnik, Croatia.

Hocquette J.F., Capel C., David V., Guéméné D., Bidanel J., Ponsart C., Gastinel P.L., Le Bail P.Y., Monget P., Mormède P., Barbezant M., Guillou F, Peyraud J.L. (2012). Objectives and applications of phenotyping network set-up for livestock. Animal Science Journal, 83, 517–528

Hocquette J.F., Van Wezemael L., Chriki S., Legrand I., Verbeke W., Farmer L., Scollan N.D., Polkinghorne R.J., Rødbotten R., Allen P., Pethick D.W. (2014). Modelling of beef sensory quality for a better prediction of palatability. Meat Science, 97, 316–322.

Kristensen L., Støier S., Würtz J., Hinrichsen L. (2014). Trends in meat science and technology: The future looks bright, but the journey will be long. Meat Science, 98, 322–329.

Ledward D.A., Hopkins D.L. (2017). Where is meat research going?. Viandes et Produits Carnés, VPC-2017-33-4-7. https://www.viandesetproduitscarnes.fr/index.php/fr/888-ou-va-la-recherche-sur-la-viande

Troy D.J., Kerry J.P. (2010). Consumer perception and the role of science in the meat industry. Meat Science 86, 214–226.

Pethick D.W., Ball A.J., Banks R.G., Hocquette J.F. (2011). Current and future issues facing red meat quality in a competitive market and how to manage continuous improvement. Animal Production Science, 51, 13–18.

Pethick D.W., McGilchrist P., Polkinghorne R., Warner R., Tarr G., Garmyn A., Thompson J., Hocquette J.F. (2018). International research on beef and lamb eating quality. Viandes et Produits Carnés, VPC-2018-34-1-2. https://www.viandesetproduitscarnes.fr/index.php/fr/894-travaux-de-recherche-internationaux-sur-la-qualite-sensorielle-de-la-viande-ovine-et-bovine

Picard B., Lebret B., Cassar-Malek I., Liaubet L., Berri C., Le Bihan-Duval E., Hocquette J.-F., Renand G. (2015). Recent advances in omic technologies for meat quality management. Meat Science 109, 18-26

Polkinghorne R.J., Thompson J.M. (2010). Meat standards and grading: a world view. Meat Science, 86, 227-235.

Scollan N.D., Greenwood P.L., Newbold C.J., Yáñez Ruiz D.R., Shingfield K.J., Wallace R.J. and Hocquette J.F. (2011). Future research priorities for animal production in a changing world. Animal Production Science, 51, 1–5.

Troy D.J., Ojha K.S., Kerry J.P., Tiwari B.K. (2016). Sustainable and consumer-friendly emerging technologies for application within the meat industry: An overview. Meat Science, 120, 2–9.