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Eating quality

Eating quality – proposals by the working group*

The following document for discussion contains proposals developed by the special working group coordinated by the delegation of Poland.

Discussion paper on developing a draft proposal for sharing of information relating to beef eating quality.

Introduction

At the 23rd Session of the Specialized Section on Standardization of Meat, the Specialized Section decided that further consultation should be made on development of a collaborative way to collect and record information on the development and keeping of protocols or procedures and data under the auspices of UNECE in the area of research into meat eating quality.

The Specialized Section agreed to establish a special working group coordinated by the UNECE secretariat with the participation of Poland as a lead Rapporteur and Argentina, Australia, France, Great Britain and North Ireland (Agri-Food and Biosciences Institute), United States and Uruguay.

* Submitted on the above date to allow for contributions from working group participants.

Poland after consultation with participants of SWG had prepared the following Terms of Reference and work schedule:

1. To identify animal, carcasses, cut and cooking characteristics that are desirable to collect in a standardised format to facilitate scientific study of eating quality relationships and prediction of consumer response – 15 January 2015.
2. To examine alternative standards that may provide consistent assessment of factors identified in (1) including availability and prospective cost of associated standards, tools or equipment, initial assessor training and systems to assess and maintain accuracy and currency over time – 6 February 2015.
3. To report and where applicable make recommendations regarding (1) and (2) – 27 February 2015.
4. To identify and recommend consumer testing protocols and standardised data collection formats to facilitate the collection and potential aggregation of international sensory test data – 27 March 2015.
5. To identify and recommend ontology principles that may be applied to facilitate individual country application while retaining a framework that facilitates international data aggregation – 30 April 2015.
6. To consider and make recommendations in regard to incorporating additional standards arising from points (1) to (5) within the UNECE Bovine meat standard – May 2015.
7. To consider the merit of utilising a UNECE framework to facilitate the assembly of international data and its use in scientific or commercial development of beef trade with particular reference to improved evaluation and prediction of consumer sensory response – 27 June 2015.
8. To report back in form of discussion document to the UNECE Working Party on Agricultural Quality Standards in regard to the matters considered – 31 July 2015.

Discussion document

Assuming that there is an agreed desire to pursue research cooperation and standardised data collection **it is recommended that a data cooperative structure be agreed to facilitate initial collection and uploading of individual country or institutional data to a shared data cooperative**.

Information supplied by Australia describes data collection principles that have been utilised in the Meat Standards Australia (MSA) database. Versions of this have also been extensively utilised in collaborative studies in Northern Ireland, Ireland, Poland, France, USA and New Zealand. It is envisaged that countries will wish to maintain individual data bases to record experimental data pertinent to local research activity but also that a substantial proportion of such data may also be combined in a data cooperative structure. To facilitate this common coding, ontology and structures are desirable. To facilitate local usage and reduce error it is considered that individual databases should utilise local language descriptions within a commonly agreed format. A language conversion format would need to be employed during merging of data in a data cooperative.

For background information the attached excel file lists the data currently recorded within the Australian MSA database together with definitions. The majority are common to that recorded in the Northern Irish, Irish, French, New Zealand, USA and Polish databases which provides a convenient base.

An extensive data dictionary may be necessary to accommodate and provide a universal ontology for all aspects of beef recording from genetics to final meal. Detailed work is already in place in regard to genomic data and a substantial effort was made within the ProSafeBeef project to document laboratory techniques. Further conversion tables for breed and other criteria will be required to enable merging in a data cooperative.

The following MSA derived criteria are advanced as a useful basis for developing standard data collection protocols for collection and testing of samples to facilitate research collaboration and enhance the ability to aggregate and compare data and experimental results.

The MSA database incorporates a number of functions and is interlinked to other software that links to trial design, collation of data and to the planning, execution and data merging from sensory testing. **It is recommended that consideration be given to establishing a suite of software within a cloud environment that facilitates establishment of equivalent data structures and associated software to assist in experimental design and execution.**

A number of fields in the MSA database relate to identification and to connection of samples with the sequence being:

- Master Group (All cattle within a trial and possibly multiple slaughters)
- Group (All cattle within a single slaughter group)
- Carcase no
- Carcase side (to allow for side based treatments)
- Primal ID (A unique ID for the cut collected at boning & often including multiple muscles)
- Muscle code (To identify the source muscle)
- Position within a muscle
- Sample code (EQSRef in MSA – a unique identifier for an individual sample to be evaluated by consumer testing)

There are also further fields that apply a unique ID to all samples from a single carcase and carcase side to overcome problems with duplicated carcase numbers. Similar routines will be required within individual databases or experiments. A universal resource of sample codes could be created if desired with a country suffix added during upload to the data warehouse to maintain unique sample identification.

Animal Measures

Section 3.5 of the UNECE Standard for Bovine Meat addresses standard codes for category, production system and feeding system which appear adequate. Further items suggested for standardised description are:

1. **Breed**. As most countries have existing well established country specific breed codes **it is recommended that a table of equivalents be established to convert individual country standards to a common format for data sharing**. It is further recommended that this common standard be developed by an expert ontological working group in collaboration with country based cattle recording organisations. Required decisions include the description of component breeds in the case of crossbred cattle and the degree of cross recorded. Are component breeds defined as % or in ½, ¼, 1/8, 1/16 etc and how many digits per breed – is Angus A, AA, AAAA etc when used as the sole breed and when defined within a

cross? **It is further recommended that a less complex breed type description be adopted to facilitate identification of beef (bos-taurus, bos indicus and European) and dairy breeds where precise breed composition is not known.**

2. **Age**. It is proposed that provision be made to record date of birth, month of birth or season of birth alternatives. Outside Europe dentition is often utilised as an age alternative but has extremely low accuracy. Skeletal ossification is also used in USDA and MSA grading systems to define maturity but again is a poor indicator of age and influenced by factors including hormonal implants, sex and nutrition. **It is recommended that age be defined exclusively by measures of chronological age and not be mixed with dentition or ossification measures.**

3. **Liveweights** at birth, weaning and pre-slaughter and defined additional points such as when placed on a treatment. **Suggest kg as weighed without curfew be adopted with an adjacent field to record feed type and hours off feed to facilitate standardisation where desired.**

4. **Muscle score**. It is recommended that a standardised live animal muscle score be defined that aligns with EUROP carcase classification.

5. **Fat score**. It is recommended that a standardised live animal fat score be defined to align with EUROP carcase description.

Carcase Measures

Sections 3.5.5 and 3.5.6 of the UNECE standard address slaughter and post slaughter systems. It is suggested that agreed definitions be developed for the post slaughter codes presented under NOTE 2 in relation to research data. These may also be utilised in commercial descriptions if useful.

Possible additions for data comparison are:

1. A further computational and reporting standard to describe the temperature at which a defined pH was reached.

2. Carcase muscling description. It is recommended that the 15 step EUROP muscle classification system be adopted as the UNECE standard. This standard has the benefit of universal existing use within Europe and there being no common equivalent system in widespread use elsewhere. **It is recommended that EUROP assessment by trained personnel or approved image analysis systems be recommended.** To facilitate data coding it is recommended that the descriptions be established as straight numeric codes of either 1 to 15 or 0.5, 1, 1.5 etc. or similar rather than + and -.

3. Carcase fatness description. Currently total carcase fat cover is assigned under the EUROP fat classes 1 to 5, with L, 0 and H subdivisions creating 15 possible divisions. In other countries rib fat depth at the 12/13 or 10/11 rib site (USDA and MSA) and 6/7 rib (JMGA) are used in assigning eating quality (MSA and JMGA) or yield (USDA and JMGA) grades. In Australia the P8 fat measure at a site over the M. Gluteus medius is utilised within the AUS-MEAT system.

   Of these systems the EUROP 15 step description is regarded as superior for overall carcase fatness assessment and related extension to yield estimates. It is recommended that this be adopted as the UNECE standard for carcase assessment by either certified assessors or approved image analysis systems. A fully numeric 15 step description is recommended.

4. It is recommended that the USDA/MSA rib fat measurement site or Japanese 6/7 rib site be utilised as a standard where desired for research or commercial grading

purposes with assessment by trained personnel or approved image analysis systems.

5. **It is recommended that provision be made for yield measures from new technology including standardised output standards to describe lean meat yield**.

Carcase and chiller assessment standards.

Prospective standards that cover the major chiller assessment (grading) criteria discussed in response to TOR 1 are published by USDA (United States Department of Agriculture), AUS-MEAT (including Meat Standards Australia (MSA) specific criteria) and JMGA (Japanese Meat Grading Association). Section 5.7 of the UNECE Bovine standard refers to meat colour, fat colour and marbling which reflect existing AUS-MEAT reference standards. From further discussion it is considered that either the USDA or MSA standards are the most assessable and have the benefit of being widely used and sharing major components. Both utilise assessment in the mid loin region ($10/11^{th}$ to $12/13^{th}$ rib) whereas the Japanese system assesses the $6/7^{th}$ rib and requires extensive training to achieve competence. The JMGA system is particularly developed to appraise highly marbled carcasses which are less common in other countries.

Both USDA and AUS-MEAT can provide training and official standards to external parties on a funded basis. The use of image analysis systems for eye muscle measures (marbling, rib fat depth, eye muscle area and meat colour) is also accredited by USDA. The Japanese system developed by Kuchida *et.al* has further technical capacity for highly detailed marbling assessment and will be commercially available in the near future. Other technologies including hyperspectral imaging, dual Dual Energy X-ray Absorptiometry (DEXA), Computer Axial Tomography (CT) and RGBD technology (Wii cameras) are also at a developmental stage where commercial meat plant application may occur in the medium term. Accordingly it would be prudent to establish language structure that can accommodate input from new technologies, both of existing traits and the possibility of further specialised inputs.

Comment on specific carcase grading inputs utilised in the USDA and AUS-MEAT systems is provided below:

1. Meat colour. AUS-MEAT produce a set of composite material based colour chips for meat and fat colour measurement (assessed under standard lighting) whereas USDA utilise printed photographic images for guidance and written description within the grading regulations. It is considered that the AUS-MEAT chips provide a more attractive solution for practical scoring in meat plants. A downside of the AUS-MEAT meat colour scale however is a mix of alpha and numeric descriptions with 1a, 1b and 1c followed by pure numerics for 2 and above which creates difficulties in data coding for analysis. In contrast the USDA colour is referenced on a continuous scale with the photographs stepping in 100 intervals but colour able to be described in units of 10. **It is suggested that the AUS-MEAT meat colour chips be adopted as a meat colour standard after re-numbering in 100 point steps, able to be recorded in 10ths to incorporate advantages of the USDA and MSA systems.**

   Appropriate arrangements for purchase of the AUS-MEAT standards and for training and certification in their use need to be agreed. The possibility of utilising objective meat colour measurement with colorimeter or spectrophotometer equipment in future, either cross referenced to an existing colour standard or to spectral specifications should also be recognised.

2. Fat colour. The AUS-MEAT reference standards shown in the UNECE language are regarded as the most appropriate available standard. Arrangements are required to facilitate purchase of the chips, training and certification in their use.

3. Marbling. For research data the finer graduated ranges used in USDA and MSA grading are recommended above the base AUS-MEAT codes shown in the UNECE standard. While both the USDA and MSA systems are very similar the scales are slightly different. **It is recommended that a marbling conversion scale between USDA and MSA scales be established by experts experienced in each system and that either be approved for research data collection.**

   It is considered that the MSA visual standards are more suitable for in plant use providing they are available for purchase and that training and certification arrangements can be established.

4. Skeletal ossification. **The USDA skeletal ossification descriptions** used by both USDA and MSA **are recommended as the International standard.** The MSA reference standards are regarded as the most appropriate for plant use provided they can be readily purchased and that suitable training and certification can be provided.

5. Hump height. This measure is utilised in estimating *bos-indicus* content in the MSA system. It also has potential as an indicator of maturity in bulls with potential for eating quality impact. **It is recommended that the MSA standard hump height assessment protocol be adopted for use where applicable.**

6. pH measurement. Where pH is to be recorded **it is recommended that temperature at the test site also be recorded and that a Bendall correction factor to 7˚C be adopted for reporting.**

   It is recommended that the USDA/MSA rib fat measurement site or Japanese 6/7 rib site be utilised as a standard where desired for research or commercial grading purposes with assessment by trained personnel or approved image analysis systems.

Assessor Training and certification.

Current training and certification systems exist in all countries which employ formal carcase assessment or grading systems. To an extent this provides a common framework for adoption of agreed international UNECE approved standards. The difficulty arises where one or more measures desired are not currently utilised in a country wishing to adopt the standard. Examples include use of EUROP muscle and fat scores outside Europe and marbling or ossification within Europe.

There are two important aspects to this issue: initial training and certification followed by retaining currency and accuracy over time. Both AUS-MEAT and USDA can provide training and initial certification on a fee for service basis either in the country desiring the service or by trainees travelling to USA or Australia. It is assumed that similar arrangements could be negotiated for EUROP application. Further assessment to maintain currency and standards correlation is possible by on site attendance of an assessment officer under each system but may be costly to maintain where carcase numbers are limited as may apply for research purposes.

In this regard the AUS-MEAT OSCAP system has advantages in using web accessible software based assessment. This is advanced as the preferred system for practical purposes as it provides a means for continual skill maintenance and development without travel. Similar benefits arise where image analysis systems are adopted and it is **recommended that uniform standards for image analysis systems be agreed by UNECE.**

Consumer Testing Protocols

While a number of trained panel and untrained consumer protocols, including the American Meat Science Association (AMSA), are commonly used in research studies it is believed that the MSA consumer testing protocols have been more widely and consistently used in recent collaborative International consumer studies. The MSA protocols have been utilised to generate standard consumer data for beef tested in 9 countries by over 135,000 consumers to date. It is recommended that these protocols be made available and considered as a base for development of an agreed UNECE standard.

Demographic input and coding of items such as income bands will need to vary between countries as will the willingness to pay scales but **it is recommended that the core utilisation of four 100mm line scales to record tenderness, juiciness, flavour and overall satisfaction and associated sample allocation to one of four categories be universal to facilitate data comparisons and aggregation.**

It is also recommended that the testing of a first common sample followed by presentation of 6 test products served in a 6 x 6 Latin square design be adopted for standard testing.

Specific cooking methods require individual protocols for consumer testing. Currently MSA has developed protocols for grill, roast, slow cook, stirfry, thin slice, yakiniku, shabu shabu and corn (salt) cooking methods. Other cooking methods may be added and the existing protocols reviewed as required.

It is recommended that the MSA consumer and associated protocols be reviewed by an expert group and appropriate changes or additions recommended. It is further recommended that standardised software be provided via a cloud based resource to facilitate trial design and management. The existing MSA structure should be considered as a base with further development to enable printing in a language of choice and alternative paper and label specifications. The practicality of providing these tools as open source code should be considered.

Data recording standards and system:

TOR 5 addresses ontology relevant to accumulating data from multiple sources for the purpose of joint analysis and potential development of eating quality prediction models. To facilitate research collaboration and efficiency through combining data for analysis, uniform description standards are required. These may be achieved by universal adoption of a common standard or by establishing conversions from local standards where appropriate. For commercial meat plant use the conversion approach may be required, at least for language to provide practical field application without confusion – for example left and right versus droit and gauche or leva and prava for carcase sides.

A further pertinent issue is conversion from local to universal description of source cuts and muscles including position within muscle. Where commercial cut is the unit to be described it is recommended that the UNECE cut description code be adopted as the standard description. Further subdivision to individual muscle portions and position within muscle must be defined. **It is recommended that the MSA codes which combine a 3 letter alpha code to designate the source primal combined with a 3 digit numeric to designate muscle be considered as a base due to their current widespread use in sensory studies and derivation from the Handbook of Australian Meat which also forms the base for the UNECE cuts description.**

In response to TOR 6 it is recommended that the ontological standards developed for a combined universal database be incorporated within the UNECE Bovine Meat Standard.

To facilitate standard development **it is recommended that an expert working group be established to define a suitable ontology and facilitate data assimilation.**

It is further recommended that a working group consider establishment of an appropriate cloud based database structure that facilitates data collection, associated trial design and application tools together with secure protocols for merging of data incorporating ontological standardisation. It is envisaged that each participating country/organisation could maintain its' own secure database and utilise standardised software to facilitate trial design and data collection plus sensory test management. Approved data could then be uploaded and merged in the global data cooperative for multi country analysis and animal, carcase and consumer application.

Use of data by researchers to develop consumer satisfaction prediction tools and related study of contributing factors.

In accordance with TOR 7 it is **recommended that a scientific reference group be established within the UNECE structure to consider practical management of a pooled international data cooperative** to facilitate the advancement of scientific knowledge, development of consumer satisfaction prediction approaches and their potential commercial application.

It is proposed that the broad objective of this activity should be to enable effective prediction of consumer satisfaction with cooked beef cuts across different consumer and source animal populations; in short to predict the response of any consumer group to beef sourced from any region. This may require appropriate prediction adjustment related to either or both consumer or animal factors.

To the extent possible it is recommended that data used for scientific analysis purposes be freely available under appropriate agreed protocols. The group should develop further approaches for potential commercial application in industry or private grading systems with an associated cost recovery revenue arrangement. **A general recommended principal is that charges for commercial access should be common to all users with the potential to distribute revenue surplus to direct system operating costs to fund continuing research and in proportion to value contributed by the founding partners and data sources.**