final report

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Cutting room traceability

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Abstract

"Food without Fear" is an important global concern with a report from Food Innovation Australia Limited (FIAL) estimating ~AUD 272 million pa fraud perpetrated on the industry in export markets (McLeod, 2017). Management of this threat is both a responsibility for individual supply chains and government. Food fraud isn't new and over time scandals have emerged within the global food industry causing both (real and perceived) public health hazards as well as economic losses.

Meat (primals, trim, offals) leave processing establishments in a carton with a label providing detailed information about the product, and a unique GS1-compliant barcode. This is probably the most vulnerable point in supply chain integrity for the product's journey to a consumer is when the contents of the carton are prepared for retail sale (trimming, portioning, offcuts etc.). There is opportunity, either intentionally, or unintentionally, for (parts of) the product description to be misapplied to the cut-up product prepared for retail sale.

This project documents the steps and procedures which are in place within Australian export licenced plants to mitigate the above risk – both systems in operation now and hypothetical ones.

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1 Background

Product integrity is key for any successful supply chain. For red meat supply chains, integrity can be backed up by transparent traceability systems. This includes tracking the chain of custody, verification of authenticity and a system to track and trace product flow. These are all forms of risk mitigation which are used in food supply chains. Achieving traceability requires cooperation throughout the whole supply chain and effective data/information sharing.

"Food without Fear" is an important global concern with a report from Food Innovation Australia Limited (FIAL) estimating ~AUD 272 million pa fraud perpetrated on the industry in export markets (McLeod, 2017). Management of this threat is both a responsibility for individual supply chains and government. Food fraud isn't new and over time scandals have emerged within the global food industry causing both (real and perceived) public health hazards as well as economic losses.

There is opportunity, either intentionally, or unintentionally, for (parts of) the product description to be misapplied to the cut-up product prepared for retail sale. This project documents the steps and procedures which are in place within Australian export licenced plants to mitigate the above risk – both systems in operation now and hypothetical ones.

Traceability in general is a relatively loose term, with the basic definition meaning the ability to trace something.

Food Standards Australia and New Zealand (FSANZ) (FSANZ 2017) have defined traceability as follows:

> *The ability to track any food through all stages of production, processing and distribution (including importation and at retail). Traceability should mean that movements can be traced one step backwards and one step forward at any point in the supply chain. For food processing businesses, traceability should extend to being able to identify the source of all food inputs such as:*
>
> - *raw materials*
> - *additives*
> - *other ingredients*
> - *packaging*

2 Project objectives

- What is the product information that need to be transmitted from the product in the carton to the cut up/portioned form?
- What approaches and procedures can be taken to ensure (prevent lack of) fidelity of information transfer during this process?
- What approaches and procedures may be taken to audit such a process?
- Additional information as required within the time frame of the contract

3 Methodology

While addressing the objectives, the following was considered:

- manual /electronic systems that are operating now, including hypothetical ones to cover the possibilities of how the objective of maintaining integrity may be achieved with existing technologies
- examples to demonstrate different approaches
- an evaluation/commentary on the suitability, acceptability, or potential vulnerabilities of these systems Regarding objective d, this relates to future information requests with the contractor acting as a “technical advisor”

4 Results

4.1 Traceability

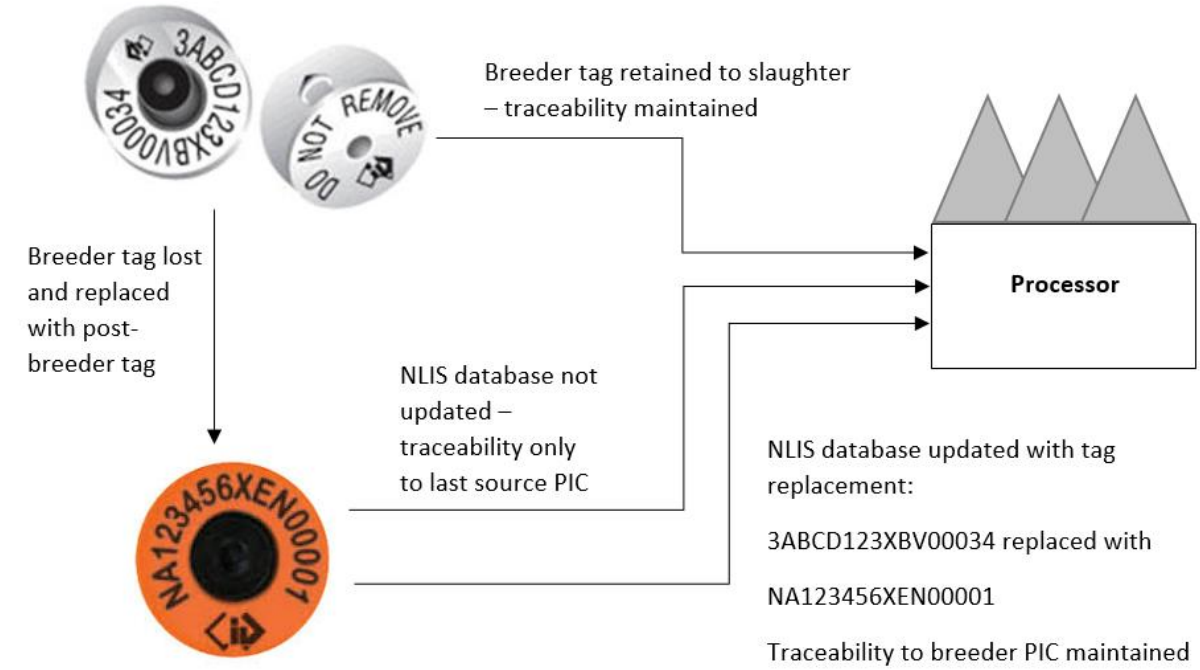
In the meat industry, traceability again has various definitions. To trace back to the previous supplier (e.g. wholesaler or processor), to trace back to a range of animals slaughtered on an individual production (boning) date or dates, to trace back to an individual Property Identification Code (PIC), or even to trace back to the original animal.

Even from a consumer’s perspective, their ideas and ideals on what traceability is varies depending on their perception of the industry.

In Australia, all properties where livestock are held including feedlots must have a registered PIC and all sheep, goats and cattle must be identified with an National Livestock Identification System (NLIS) device which displays the PIC the device is registered to visually on the device or associated device ear tag in the case of rumen boluses. In cattle and some sheep and goats, the NLIS device is fitted with a Radio Frequency Identification (RFID) which includes an individual identification number for each animal.

All livestock slaughtered must be traceable back the source PIC with the use of an NLIS deceive. Often the animal is able to be traced back the property of birth. If during the course of their lives they lose their original NLIS breeder tag, and a post breeder tag is applied, the lifetime traceability of this animal stops unless the producer updates the NLIS database with the replacement tag details as required under their optional accreditations or they choose to out of best practice.

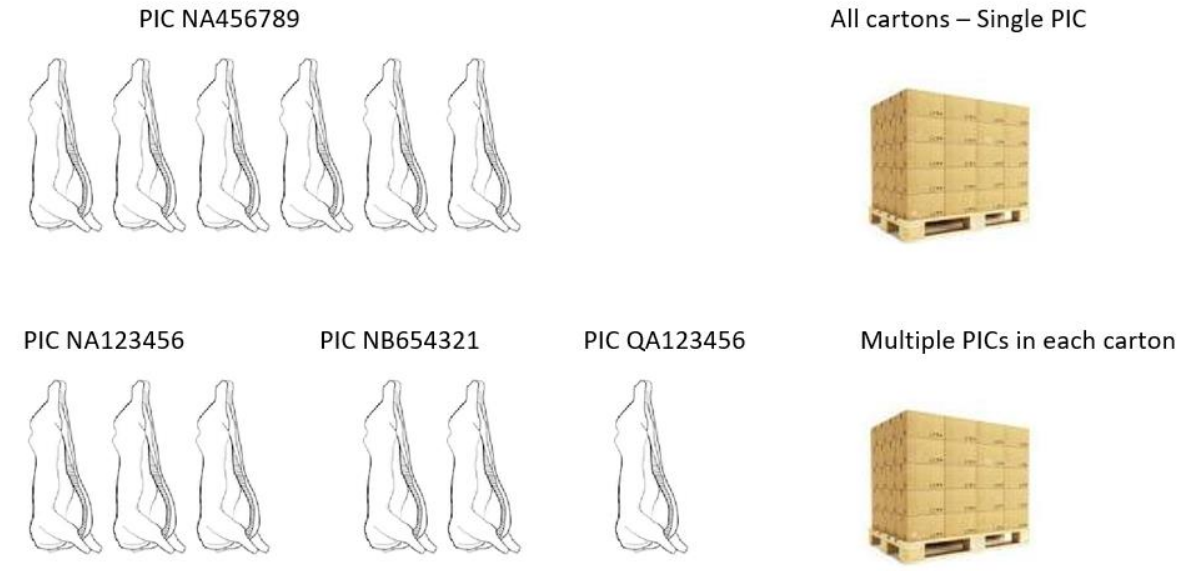
Figure 1: NLIS tags



When animals are slaughtered in Australia, a body number is applied to the carcase which correlates back to the source PIC and RFID where available. This information remains with the carcase while ever the carcase tag remains attached, which is usually up until the point of boning where carcases or carcase parts are broken down into primals, sub primals and trimmings. At this point, traceability on individual pieces will depend on the processes implemented in the boning room to maintain that traceability.

Traceability on the end carton back to the individual RFID or PIC is optional for processors, however traceability must be maintained back to a list of source PICs, for example, a range of PICs supplying carcases into a boning room in a defined period or batch. Where the processor chooses to provide traceability details to the customer back to the source PIC or even breeder PIC, the more source PICs boned in a single day, the harder this can be.

Figure 2: Carcase to carton



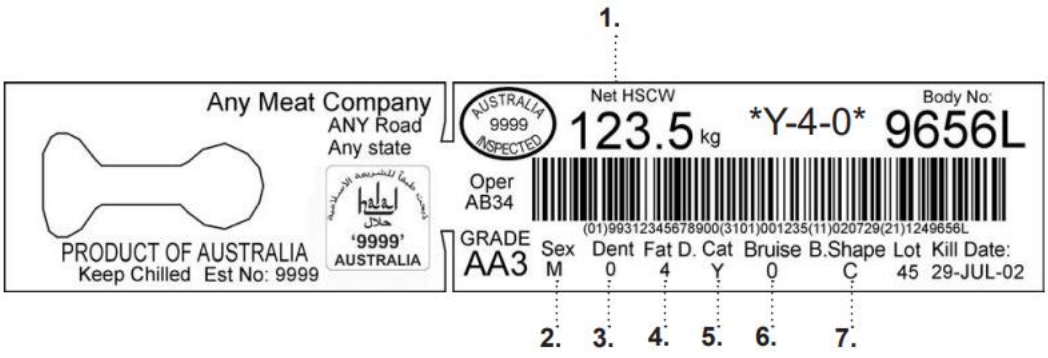
For the purpose of this report, the focus for traceability is being able to trace meat products back to the country of origin, in this case, Australia.

4.2 Manual / Electronic systems currently in operation

Finished products at a processor are identified with a label that identifies a number of elements as per the AUS-MEAT label examples provided below. This information includes the production date of the product in addition to the establishment where the product was processed.

4.2.1 Carcase

Figure 3: Label example (Source AUS-MEAT Handbook of Australian Beef Processing, 2020 edition)



AUS-MEAT Slaughter Floor Language characteristics

1. Hot Standard Carcase Weight (HSCW)
2. Sex (male/female)
3. Dentition
4. P8 fat depth (mm)
5. Category (sex and dentition)
6. Bruise score
7. Butt shape

4.2.2 Carton

Figure 4: Label example (Source AUS-MEAT Handbook of Australian Beef Processing, 2020 edition)

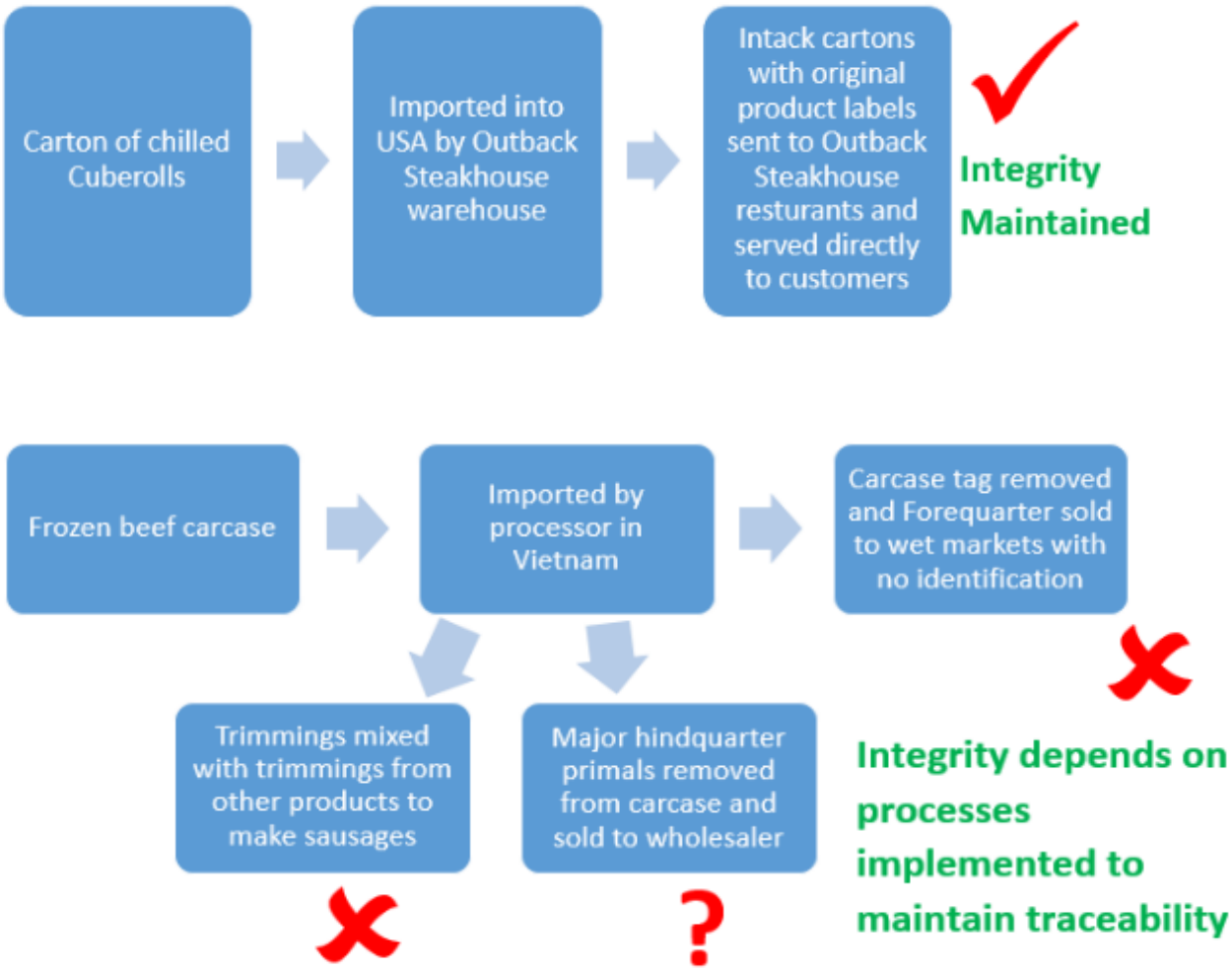
1. ***GENERIC:*** Bone-in or boneless statement as well as species identification.
2. ***CARCASE IDENTIFICATION:*** Category cipher which identifies carcase age and sex.
3. ***PRODUCT NAME:*** Primal cut description as shown in the Handbook of Australian Meat.
4. ***GRAINFED DESCRIPTION:*** Identifies the product as meeting Grainfed requirements.
5. ***CHILLER ASSESSMENT:*** Chiller Assessment attribute statement.
6. ***MSA DESCRIPTION:*** Identifies the product as MSA graded with eating quality outcomes.
7. ***NET WEIGHT:*** The meat content of the carton minus the carton weight.
8. ***AI STAMP:*** Australian Federal Government Inspected stamp.
9. ***REFRIGERATION STATEMENT:*** Indicates the product has been held in controlled chilling.
10. ***COMPANY DETAILS:*** Indicates the name of the packer of the product.

Barcode information on these labels should follow the standard GS1 labelling method which is an international approach to enable barcodes to be read by multiple companies no matter their language. GS1 labelling systems have been developed in line with the EAN UCC System, which is an internationally accepted method of identifying products allowing for electronic flow of information along the supply chain.

Australian carton label barcodes can be verified and traced with the industry owned electronic MeatMessage program which is a 'web-based application which facilitates the collection, processing and reporting of commercial and regulatory meat product information along the supply chains', *AUS-MEAT MeatMessaging presentation, July 2018.*

This label information is able to be tracked to the importing countries port through export documentation, however once product has left the initial importing company, traceability is not always able to be maintained, depending on the technology implemented by various customers along the supply chain. The longer the supply chain, the greater the risk of traceability back to Australia being lost. In addition, some supply chains, whilst only short, have minimal traceability procedures in place. The following examples are two different supply chain examples with different customer bases showing the range of traceability challenges.

Figure 5: Supply chain models



It is important to note that unless the meat is exported directly to the end retailer or caterer / restaurant chain, the movements along the supply chain are almost limitless up to the end of shelf life, that is, up to the point that the meat still meets organoleptic expectations for meat for human consumption.

- Chilled meat has varying shelf life best before limits ranging from 1 to 2 weeks for atmosphere packed meats, mince and portion cuts to approximately 90 to 120 days for vacuum packed primals. This chilled meat may however be frozen after export and legitimately have the shelf life extended.
- Frozen meat will usually have a shelf life of 1 to 2 years for the best before date. Both chilled and frozen meat may be relabelled along the supply chain and have the shelf life fraudulently extended.
- Meat may be exported to another country after receival by the initial importer.

- Whilst the relabelling of meat is not able to be controlled, the challenge is to provide a supply chain where the end consumer can be assured that they are actually consuming Australian meat.

Ideally, when transmitting information from a supplied meat product to a label on a value-added meat product, all identification information should be available on the new label to enable full traceability.

Whilst all this information may not be able to be transferred from one label to the next, the initial production date and establishment number should be transmitted on all labels through each point in the supply chain up to the final customer (i.e. retail or catering) to enable traceability back to the point of processing.

Similarly, detailed ledger technology should include traceability information from each step in the supply chain on all products used to create the finished consumer ready product. That is, the finished information on a corned roast or beef and lamb meatballs for example should include traceability for all ingredients used.

4.3 Emerging traceability systems

Shelf ready packs such as thermoform packs and oven ready packs are advantageous for maintaining traceability as they do not require businesses to bone and slice meat and meat products into the desired cut, reducing the risk of substitution. The disadvantage of this system is that the shelf life of the meat is reduced and may not allow adequate time for overseas shipping, although packaging providers are continuously improving their technology to increase the shelf life of the product.

Figure 6: Retail packaging

Some companies have found benefits in having value add facilities in the importing country so they can vertically integrate to enable the production of shelf ready products within the desired country and therefore reducing the risks of fraud on their brands, whilst providing a product with adequate shelf life.

With such a large range of technology available to the everyday business, the risk of labels and security devices being copied is every increasing. Anyone with a digital camera including cameras within phones can easily take a photo of a brand image and turn it into a sticker to apply to their own products.

For this reason, particularly with branding, companies are often updating their visual image to stay in front of copy-cats. The disadvantage of this is that some consumers will continue to choose the product with the original image as they believe new labels can be the fraudulent label. This highlights the importance of continued marketing when brand images are updated.

To reduce the risk of labels being copied and products being substituted, suppliers are starting to implement technology to reduce these risks. Some of these technologies include secure digital markers on labels, token driven systems and blockchain technology.

Many emerging technology providers such as AgLive (https://aglive.com/), Fresh Supply Co. (https://freshsupplyco.com/) and BEEFLEDGER (https://beefledger.io/) are harnessing combinations of digital technology including blockchain and associated tokens. Other companies are working with supply chains to provide collaborative networks across the entire supply chain to guarantee provenance.

Meat brands such as Cape Grim and King Island are using QR (quick response) codes on their packaging that can link back to source PICs, however individual PICs are not always available, and these codes are not available on all their value-added packaging.

Accounting firm Pricewaterhouse Coopers has developed an electronic etching procedure that 'creates an invisible, trackable barcode for beef based on edible, non-toxic silicon dioxide' forming 'a crypto anchor that can be scanned using a hyper-spectrum gun' or an 'edible fingerprint' *(Financial Review - Aug 10, 2018 — 11.45pm Cracking down on fake steak with invisible, trackable beef barcodes, https://www.afr.com/life-and-luxury/food-and-wine/cracking-down-on-fake-steak-with-invisible-trackable-barcodes-20180810-h13t3n).* With the potential to apply this etching at each stage of the supply chain, individual cuts could be scanned, assuming you have access to a hyper spectrum gun.

4.4 Challenges for the Digital Approach

When implementing blockchain technology to certify a products traceability, the blockchain of data must link back to the original carton label applied after initial boning as this label links to the carcase or carcases that could have contributed to the carton of meat.

Similarly, if products are value added along the supply chain, any subsequent label data and equivalent traceability information such as ingredient batch numbers should be included within the blockchain to allow for full traceability.

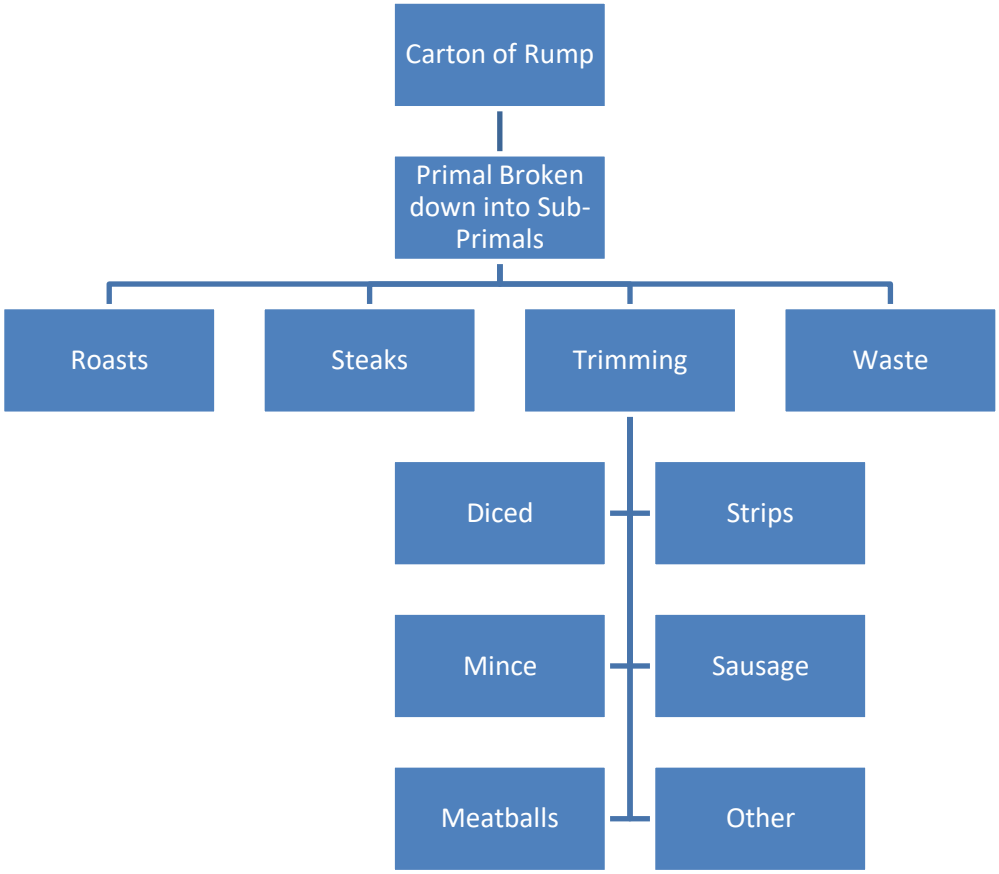
One challenge that many customers have is that due to the range of labels being provided, they are not always able to be scanned into their electronic inventory systems.

Where companies do not have the technology available to show electronic traceability from incoming labels to outgoing labels, this data would have to be maintained using other records. Whilst these records can be verified in an audit situation, it can be almost impossible to determine traceability at the time of sale to the consumer.

In addition, when there is not just Australian meat being processed at a value-add facility, there is a significantly increased risk of substitution.

A challenge with systems that determine allowable outputs, i.e. tokens, is that there are an unlimited number of pieces that a primal can be broken down into. The system therefore needs to be weight based. However, when determining weight, the wastage needs to be taken into account. For example, where an entire carcase or carcase side is exported, the breakdown of this carcase will vary depending on the desired cuts, as demonstrated in the below image, and therefore the weight of bone, fat and waste trimmings that are not sold for human consumption will vary.

Figure 7: Product breakdown



Similarly, if a carton of rump is exported, the usage of this rump will vary depending on the consumers demand, and therefore the weight of waste will vary (although not as much as a bone in primal). In addition, if the trimmings and subprimals are value added with ingredients, the weight can increase, in the case of injected products this can be an increase of around 30%.

Therefore, where weights are used to determine allowable outputs, the system needs to be robust enough to accommodate all value-add facilities and retailers without permitting fraudulent behaviour.

Any system implemented should allow for a mass balance to be completed, ideally automatically, to verify compliance, where the Total Mass In = Total Mass Out + Total Mass Accumulated During Production.

For example:

10kg Rump + 1kg Pre-Mix + 1kg Water + 0.25kg Sausage Skins = 0.5kg Waste + 11.75 Sausage

4.5 Verifying the Process

Depending on the technology implemented by the auditee, and the range of products they are supplying, audits need to be vigorous to address all different systems whilst still identifying fraudulent activities such as labels being copied, or products substituted.
Auditees must be able to provide a mass balance when performing traceability to show that the weight of incoming products matches the weight of outgoing products including packaging and wastage.

Where companies are using numbered labelling systems with blockchain technology to show traceability, labels that can be scanned and verified electronically using applications by the customer or consumer can help demonstrate a products integrity. There does however need to be an element of trust combined with an element of verified accountability to show that the company packaging the products can be trusted. This trust can be strengthened via third party auditable systems that verify there has been no substitution.

Companies such as Oritain (https://oritain.com) have developed scientific testing methods that can compare 'natural fingerprint' of an individual piece of meat by testing the trace elements and isotopes and compare it against the country of origin's 'origin fingerprint' to verify the source area, *(https://oritain.com/how-it-works/the-science/).*

This testing is becoming more affordable and may be a valuable tool into the future to verify country of origin for meat products, especially in countries where there is a higher risk of food fraud and substitution. At this stage, these tests do not provide a rapid result and are therefore not practical from a consumer perspective. Consumes would however have a reduced risk of purchasing substituted meat when purchasing products from certified retail outlets.

5 Conclusions/recommendations

Because of the value of Australian meat products (both perceived and financial), these products are very popular in the global marketplace. It appears that because of the popularity, there could forever be a risk of Australian meat products being substituted in export markets.

Food Fraud and the ability to guarantee traceability or provenance is continuing to gain momentum as an important factor for consumers when selecting which products to purchase, and which ones are worth paying more for. On top of traceability, a report developed by AgriFutures National Rural Issues as part of their Provenance storytelling for success scheme, titled Consumer trends and storytelling technologies report, February 2020, detailed that along with the many growing fields of technology to combat food fraud and provide provenance, the art of storytelling must go hand in hand with the technology to show consumers the positive attributes of the product, e.g. Australian grown, as well as giving consumers the desires level of trust around the provenance of the brand.

It is apparent that one individual system will most likely not result in full traceability, that the system needs to include various aspects such as blockchain network systems combined with secure digital markers.

One of the biggest hurdles that the industry faces when implementing new technology is the lack of understanding that processors are experts in the production of quality assured meat products, they are not necessarily technological experts, especially in areas like distributed ledger technology. And in turn, technology experts do not necessarily understand the various supply chains in the meat industry and how to control the variables.

Whilst many processors have heard of blockchain, QR codes, security labels, etc, determining how they can benefit their company and the integrity of their supply chain can be challenging, especially when bombarded by a multitude of sales reps selling various technology that may sound like gobbledygook.

If a processor is producing export lamb, and they have a strong customer wholesale market, what is their financial benefit for supplying traceability guarantees for the end consumer? This is where a national government approach that has the ability to grow and change with technology would benefit the entire industry.

The Australian livestock industry went to great lengths to enable traceability of animals for disease control and other biosecurity measures. NLIS was first introduced in Australia in 1999 as part of producers European Union access requirements. NLIS cattle was introduced in 2004 with gradual mandatory implementation into the beef, sheep and goat industries due to the government and industry seeing the opportunity of the system to improve Australia'. It was found that unless a national government approach was initiated, the system would not be fully implemented.

Similarly, to ensure a robust traceability system is fully implemented for Australian export meat, a government implemented uniformed approach for identifying Australian meat would mean all exporters have access to the same baseline technology and Australian marketing can focus on educating overseas consumers on methods for identify Australian meat. This would provide a baseline guarantee for all Australian meat with additional storytelling and technology still available for individual brands where desired by the exporter.

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