

Eel Product evaluation and shortlisting

February 2020

This report details an evaluation of an eel shipment received in December 2019 and then processed in February 2020.

Eel receival process

Two batches of eels were used for this assessment.

The first batch of eels was delivered live within three days of capture with no penning or purging).

The second batch of eels was caught using the trapping method. They were penned for five weeks with no feed. They were put to sleep in an ice brine and shipped directly to Noosa via refrigerated freight. The eels were packed on ice and had a core temperature of 0°C. when received. The total weight received was 64.1kg and was representative of an average catch. The eels were initially weight graded using 500g increments.



Fig 1: Core Temp upon receival.

The eel's appearance upon arrival would be considered darker than generally normal for live caught eels of the same species. It was also observed that the eels looked skinny, lacking body fat.

Once the fish were graded, they were vacuum-sealed and blast frozen.

Processing

On the 10th of February 2020, the eels were left to thaw in a cool room overnight. The eels were then processed skin off (see **Fig 2** below) and then steamed for 1.5 hours at 80°C. Once cooked, the product was tasted and compared against a number of factors. See Table 1 below.



Fig 2. Processed eel skin off.

Table 1: Summary results from the tasting trials

Size	Texture 10 toughest	Colour 10 yellow 1 white	Flavour 10 Best	Fattiness 10 Fattiest	Cooking Method	Cooking time	Comment
3+kg	8	2	5	0	Steam 80 deg	1.5hr	Dry
1.5 to 2kg	7	2	5	0	Steam 80 deg	1.5hr	Dry
1 to 1.5kg	5	2	6	0	Steam 80 deg	1.5hr	Dryish
500g to 1kg	4	2	7.5	3-4	Steam 80 deg	1.5hr	Dryish
500g to 1kg	5/6	3	5	2-3	Steam 80 deg	1.5hr	Dryish
u 500g	4/5	3	5/6	2--3	Steam 80 deg	1.5hr	Dryish

The two batches of eels were then compared. The following is a summary of the differences.

1. Penning eels appears to create a purging effect removing the muddy/earthy flavour from the flesh.
2. Prolonged penning starves the eels, reducing body fat content and impacting on the palatability of the eels. Concurrently reducing the yield in kilograms back to the fisherman.
3. Increased size of the eel increases toughness/coarseness of flesh.
4. Flavour seemed to be most palatable in eels below 1.5kg
5. Fat content also seemed higher in eels below 1.5kg
6. Colour was constant throughout.

Product variability

There can be significant product variance depending on the region and whether they were caught in brackish water with a sand bottom or freshwater with a muddy bottom. Initial testing with fresh water, muddy bottom eels resulted in very unpleasant tasting eels. It was deemed that these could not be used for human consumption as the flavour was very overpowering. Further testing of eels that were harvested from brackish water and sand bottom resulted in a yellow tainted flesh with high-fat content and no muddy or earthy flavour. However, both samples were firm and coarse in texture, which increased with size, coupled with a rubbery skin that was found to be unpleasant and inedible on all sizes.

Comparison with Japanese and Taiwanese Unagi eel product

An adapted version of Unagi was produced with the smallest (u500g to 750g) eels sourced from brackish water and sand bottom. The eels were skinned and soaked in a brine solution (proprietary) for various times then steamed at a very low temperature.



Japanese produced

Taiwanese produced

NSM produced

Retail Price \$300/kg

Retail Price \$65/kg

Both the Japanese product and the Taiwanese produced product was from farmed eels of a different species. Both also has skin on, where the Australian eel sample produced, we removed the skin.

A direct comparison is obviously difficult as the species are significantly different and the exact cooking method of the Japanese and Taiwanese samples varied from the Australian product. However from a taste and texture perspective the Australian product was comparable with the Taiwanese product, in fact the Taiwanese product was muddy in flavour even though it was accompanied by a very strong sweet sauce (this muddy flavour is also prevalent in product produced in China). The Taiwanese product has a skin that was just edible, whereas we removed the skin on the Australian product. The Japanese produced product was a significant stand out, this is reflected in the price.

Factors impacting on taste and fat content

Based on the two trials it appears that the flavour and texture of the eels and the fat content is impacted by several factors including:

1. The region the eels are caught; dams and freshwater sections of rivers tend to produce a muddier/earthier flavoured eel that tends to have whiter flesh which indicates fat content being lower. Eels caught in brackish and saltier water with a sand bottom tend to produce a cleaner flavoured eel with a more yellow coloured flesh tending to have a higher fat content.
2. Method of capture does not seem to impact flavour or texture.
3. Penning after capture can decrease the muddy/earthy flavour
4. Prolonged penning without feed starves the eel, reducing fat content.
5. The size of the eel impacts on flavour and texture, larger eels tend to have less overall fat content and were found to be tougher, more coarse flesh.

Conclusions

These trials demonstrate that the eating quality characteristics, flavour and texture, are impacted by the region the eels are caught as well as the size and fat content of the individual eel.

The smaller eels, when sourced from brackish water, are able to be “value added” into an acceptable product. The recovery rate and additional labour based on skin removal does render it potentially more expensive than some current Taiwanese and Chinese produced products.

The larger fish, with careful brining, can be smoked and used in value added products with eel as a main protein ingredient. This is due to the firmness and texture of the flesh and the limited fattiness (moisture) in the flesh. By using the eel in this manner those characteristics

can be largely compensated for by breaking down the structural integrity of the eel and using additives to compensate for the lack of moisture normally present in a fattier eel.

Further research

Based on the significant irregularities of the eels, dependant on source, some level of penning would be required to produce a consistent product, whether it be live or value added.

It would stand to reason that eels once captured can be penned and while being purged of the muddy flavour fed a high calorie diet to increase fat content. Although preliminary evidence does show that the taste (Muddy/earthy) can be removed by purging further experimentation needs to be done. Researching how to increase the fat content of the eels whilst in captivity should also be undertaken as the fat content has a direct impact on the palatability and therefore suitability to producing a marketable value-added product.

Shortlisted new product development

The product ideas established earlier in the project were revisited.

Using the factors outlined above the eel's suitability was assessed across the range of cooking methods and culinary styles. Consideration was also given to market preferences where the potential for the run of catch Australian eels may sit.

Based on this assessment the products highlighted in yellow were selected for further development:

1. Whole live eel
2. Processed graded frozen (gilled) bulk packs
3. Smoked Eel
4. Kabayaki (Unagi) (smaller eel)
5. Smoked Eel fish cakes
6. Jellied Eels
7. Pickled Eel
8. Eel pieces in Spicy Stew
9. Smoked Eel rillete
10. Sous Vide Eel

The other products identified in the first stage of product ideation will also be considered as they have the potential for waste minimisation in the processing stage.

We have further narrowed the best options based on relative market size and suitability to the apparent eating characteristics of the eels. Samples were sent to Japan for assessment by Japanese end users (chefs, product developers, retailers and wholesalers).

- Interest was shown in live products and in bulk minimally processed bulk packs.

- Japanese buyers were also interested in Kabayaki eel with some further refinement. The samples provided to them were based on non-penned eels u500 sizes. We understand that eels up to 1kg may be suitable for Kabayaki but the U500g are the most suitable.
- The eels that are 500g up to 1.5kg are suitable for smoking.
- The 1.5kg plus eels are only suitable for smoked eel fishcakes and rillette and for the eel pieces in a spicy stew. Further work could be undertaken using traditional Japanese processing methods for the larger eels.

Next steps

Samples of the following five products will be developed and ready for assessment by Japanese and Korean experts.

1. Processed graded frozen bulk packs ready for further processing by customers
2. Smoked eel (including a value-added product either smoked eel cakes or smoked eel rillette)
3. Kabayaki (Unagi)
4. Eel pieces in spicy stew (ready-meal option)

During the process any opportunities for using processing waste products eg roasted eel bones will be further explored.