Improving Livelihoods of Rural Communities in Fiji by Increasing Economic Benefits from Fiji’s Kai Fishery *(Batissa violacea)* by Addressing Food Safety

Project Number P000761

Richard Beyer
April 2016
ACKNOWLEDGEMENTS

This work would not have been possible without the support of the Embassy of the Republic of France whose contribution is acknowledged with enormous gratitude. The implementing agency – the International Union for the Conservation of Nature played a major role in facilitating the project. In particular the hard work invested by Dr Milika Sobey to initiate the project and the continuing wise counsel of Epeli Nakautoga have led to a successful conclusion of the project.

The wonderful fishers of Muana have been central to this effort and their good humour, generosity and willingness to partake have been an inspiration and the bases of long lasting friendships.

Their unforgettable gifts of time will be remembered with gratitude.

The management and staff of the Korinivia Research Station Product Development Laboratory gave of their time and facilities willingly and with good grace. They are thanked for their efforts.

Arun Pande and her staff in Microbiological Laboratory at the Institute of Applied Sciences conducted the microbiological assays with diligence and good grace.

The Sai Yee Company at Lami were generous in hosting the visitors from Muana.

All these people have enriched this aspect of Fiji life.

Thank you.

Richard Beyer

April 2016
## CONTENTS

<table>
<thead>
<tr>
<th>Acknowledgements</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Executive Summary</td>
<td>3</td>
</tr>
<tr>
<td>1. Introduction</td>
<td>5</td>
</tr>
</tbody>
</table>

| 2. The Traditional Process              | 7    |
| 2.1 Untreated Kai                       | 7    |
| 2.2 Depuration                          | 7    |
| 2.3 Shucking                            | 8    |
| 2.4 Evisceration                        | 9    |
| 2.5 Freezing                            | 10   |

| 3. Risk                                  | 11   |
| 3.1 Harvest and Depuration               | 12   |
| 3.2 Shucking                             | 12   |
| 3.3 Evisceration                         | 13   |
| 3.4 Food Handling                        | 13   |
| 3.5 Sodium meta-bisulfite                | 14   |

| 4. Trials                                | 15   |
| 4.1 Methods                              | 15   |
| 4.2 Results                              | 16   |
| 4.3 Discussion                           | 17   |
| 4.4 Conclusions                          | 19   |
| 4.5 Significant Outcomes                 | 20   |

| 5. The Market/Value Chain                | 21   |
| 5.1 The Value Chain                      | 21   |
| 5.1.1 Depuration                         | 21   |
| 5.1.2 Shucking                           | 21   |
| 5.1.3 Freezing                           | 21   |
| 5.1.4 Evisceration                       | 21   |
| 5.1.5 Estimating Return for Effort       | 22   |
| 5.2 Value Adding                         | 23   |
| 5.3 Conclusions                          | 24   |

| 6. Funding                               | 25   |

### Appendices

| 1. Bacterial Standards for Fish and Fish Products | 27   |
| 2. Agenda Item National Codex Committee         | 28   |
| 3. Draft Code of Practice (CoP) for Kai and Kai Products | 29   |
| 4. Public Advisory for the safe Handling of Kai | 34   |
| 5. Food Handling Training                      | 35   |
| 6. Fittings Required for Processing             | 43   |
| 7. References                                 | 44   |
| 8. Scope of Work (IUCN)                        | 46   |
| 9. Hedonic Scale                               | 48   |
EXECUTIVE SUMMARY

Only in very rare situations is the full value of kai realised. Market acceptance is inhibited by uncertainties about its safety and its convenience in a world of instant gratification from food. Traditional methods of soaking and exchanging water (depuration) followed by extensive cooking for tenderisation have been used for many generations. This institutionalised knowledge may not be as comprehensively known as in former years since Fiji is enjoying increasing numbers of self-catering visitors including backpackers who are anxious to enjoy all aspects of Fiji, including its food. A draft public advisory has been prepared to ensure that risk is minimised for this group and for increasing numbers of urban Fijians who are becoming progressively divorced from traditional practices down the generations. The risk remains that kai can be a source of bacterial infection if processing is not diligent, if it is re-infected during table preparedness by handlers and by cross-contamination. These issues have been addressed in this report.

The work was stimulated by the prospect of exporting through a partnership with a private sector actor – the Sai Yee Company. Their evolvement towards export requires removal of the viscera from kai (evisceration) a tedious and time consuming operation adding little value for the effort invested. In its favour the evisceration process has proven to be a rapid means of achieving conformity with international standards. The link with private sector was to prove unacceptable, however not only because of the low price offered for eviscerated kai but also because of deficiencies in the on-site manufacturing practices.

The analysis of the value chain for kai has indicated that most value can be extracted from kai after depuration and shucking (shell-removal). Shucked kai is most instantly recognisable and it is an obvious candidate for further processing. Shucked kai has a very short shelf life so immediate intervention is required for shelf-life extension. Freezing is the technique of choice and indeed is predicated by occasional appearances on supermarket shelves of frozen pre-packed product. It is also the technique with which Hotels and Tourist outlets are most aware through their familiarity with imported green lipped mussels with which kai promises to compete. A Code of Practice for kai processing has been developed here for further consideration though the normal channel of the National Codex Committee – the conduit by which issues are discussed prior to entry into the public domain.

A looming threat might be the increasing average age of fishers and the apparent dwindling interest among younger community members, a trend that might be stemmed if there is an improved return for effort. For sustainability (profitability) of enterprises three elements are vital:

- An adequate supply of raw material of the appropriate quality;
- Technical facilities and equipment to affect changes that suit market requirements;
- The market.

The kai resource does not seem to be under threat but the extent to which it is harvested may be diminishing. For a single village to be able to access funding to refurbish extant village facilities is a distant hope. Greater momentum in the enterprise perhaps by an amalgamation of effort would engender greater promise for funding for adequate processing facilities. Empowered with suitable amenities, the real increase in return for effort through the production of safe, convenient, frozen kai becomes a probability. A degree of cooperation among like-minded entities is a favoured strategy and the steps towards this are mooted through the recommendation here.

Cooperation requires a continuing resolve to contribute to the greater good. The Nature’s Way Cooperative is an example that seeks to ensure equitable disbursement of rewards to contributors. Processing in depth and further value adding are activities for the future. Perhaps this is the pathway to realise the full potential of this wonderful resource.
1. It is recommended that the labelling instructions on retail packs of frozen kai include the statements:
   ‘Store a -18°C prior to use.’
   ‘Boil for at least 10 minutes prior to consumption.
   These items are pertinent to the Code of Practice (Appendix 3).

2. It is recommended that a draft ‘Public Advisory,’ containing the elements that allude to correct handling should be submitted to the National Codex Committee for discussion and ultimate action by the Ministry of Health.

3. Shucked kai will deteriorate and become infective extremely quickly even if it has been depurated efficiently. It must be cooked, frozen or at least chilled without delay.

4. Chilling merely delays spoilage. For every 10°C drop in temperature the rate of spoilage is halved.

5. Any biological activity however ceases completely at -18°C which is the upper limit for storage of frozen foods set by Codex.

6. It is recommended that a feasibility study is undertaken to assert if there is significant will among the eastern Provinces to establish cooperation and hence movement towards a formalization of the industry.
   The Terms of Reference to be defined after consultations with all interest groups including the fishers, Provincial Council, The Ministry of Youth and Sport, the Ministry of Trade, the Ministry of Health and the Ministry of Women and Poverty Alleviation.
Improving Livelihoods of Rural Communities in Fiji by Increasing Economic Benefits from Fiji’s Kai Fishery (*Batissa violacea*) by Addressing Food Safety

1 INTRODUCTION

Reported cases of food poisoning at the two main hospitals in Suva (the Colonial War Memorial Hospital and the Suva Private Hospital), exceeded 500 in 2014 (Beyer, 2015). This figure is somewhat disturbing since access to these hospitals is too costly for many Fijians living in rural communities. In addition, many food poisoning cases are dismissed as ‘running tummy,’ during which patients seldom seek medical assistance and hence, are never documented and so recorded figures are probably only a small portion of the total cases. In any event food-related illness is hugely, socially distressing and also represents a significant drain on the economy through absenteeism and Fiji’s reputation as a tourist destination.

In many instances, food poisoning causative organisms are not identified but *Shigella* spp and *E coli* have been identified in a significant number of cases. Outbreaks of typhoid command reports in the popular media but the origins of the *Salmonella* spp are rarely identified. These organisms are sufficiently correlated that one species is an indication of the other. Traditional food practices including lovo events, which involve frequent delays between serving and consumption, hygiene practices and vermin access that are hampered by lack of facilities are likely causes. Kai consumption may be a contributor to these figures however, and this report endeavours to discuss risk and its mitigation.

Fiji is one of 12 countries in which kai (*Batissa violacea*) is considered to be indigenous. These include: Fiji, the Philippines, Vanuatu, Indonesia, Malaysia, PNG, Brunei, Singapore, Timor Leste, Solomon Islands, Australia, Palau. In none of these countries is there evidence of commercialisation above subsistence selling.

Kia is a shellfish with a unique flavour and texture. It is commonly offered for sale at the roadside or in the municipal markets shell-in and consumers are then faced with task of soaking and de-shelling (shucking) the kai. Lack of convenience alone and perhaps the decline in traditional knowledge among second and third generation urban dwellers in Fiji are threats to its market demand.

Kai fishing is common in communities close to river banks where it is important for income generation and as a protein source as an element of food security. At its current harvest rate the fishery appears to be sustainable. Surveys by the Fisheries Department in the mid-2000s show that about 2,500 Tonnes of kai was marketed annually. Climate change susceptibility is considered to be ‘moderate,’ to ‘low,’ depending on the degree of tidal position, sea level rise and hence salination. For the immediate future the rate of harvest is considered to be sustainable (Bell *et al*, 2014).

Kai fishing is carried out by women and takes place in the shallow parts of rivers, where the shells are located by hands and feet (Food and Agriculture Organisation - FAO, 2014). The practice is generally recurrent, depending on weather, tide, confounding social demands and financial imperatives. If Muana village is typical there is a disturbing shift in the kai fishing demographic. The numbers fishing are ageing and declining in numbers. Maybe there are strategies that can improve the perceived return for effort among rural villages traditionally known for their kai production.

There is nascent interest in commercializing the fishery with demand from overseas for frozen, eviscerated kai. It is also, intermittently available in Fiji, in frozen, shucked form in selected supermarkets. Further demands on the resource resulting from expanding commercialization may require further evaluation of the resource but there appears to be no apparent threat.
Hatha et al (2005) and Layugen (2015) have reported a wide range of bacteria in kai but that the aerobic plate count and **E. coli** levels are considered to representative of the flora. These species may give an indication of human contamination. Microbiological assessments are expensive in Fiji so testing was limited to these two assays. **E. coli** was chosen as indicator organism since recent accounts (Randolf et al, 2010) have reported that the organism can adapt to growth at high temperature and is therefore likely to persist during food handling. At the same time the aerobic plate counts (APCs) were used as an indicator of general sanitary standards. Using these two evaluations the standards achieved here can be compared to standards specified by the International Commission on Microbiological Standards in Foods (ICMSF) now Codex Alimentarius (See Appendix 1).

However, many other organisms may be present (GDR/NRL, 2015). For instance, the food pathogen **Clostridium perfringens** is associated with excreta from non-herbivorous animals and sewage (Vierheilig et al, 2013). It is a possible candidate for food infection since its presence is possible especially since pit toilets can overflow during flooding and pigs are known to run free in some inland villages. This organism forms heat-resistant spores and hence there is a chance that it will survive the heat treatment during shucking. Its pathogenicity lies in its toxin which fortunately is destroyed at low temperatures. The spores can survive for extended periods and germinate to release toxin – perhaps as dishes are prepared and held in *bain maries*. A number of additional genera may present and may pose risks. Typhoid occurs occasionally in Fiji but its link to kai is tenuous because **Salmonella spp** are relatively heat labile with a decimal reduction at 62°C of 36 seconds (Ng et al. 1999). Enterobacteria spp have a decimal reduction at 57°C of 60 seconds (Breeuwa et al, 2003). **Klebsiella pneumoniae** which has been identified as significant in occurrence at the CWM laboratory has a decimal reduction at 59°C of 62 seconds. Many food handlers can be symptomless carriers of these organisms so that food hygiene is of paramount importance and this is the likely vector for contamination.

In addition, there is a significant chance that viruses may also be present since they have previously been reported (GDR/NRL,2015; Bosch, et al, 2010), but are unlikely to survive the cooking time required to tenderise the kai. Although they are not likely to survive shucking and cooking, cross contamination may occur between cooked and raw kai if hygiene practices are ignored.

‘Risk,’ relates to the chances that hazards are realised. Risk is most effectively addressed using the Hazard Analysis and Critical Control Point (HACCP) approach of assessing the risks associated with the fishery. Hazards fall into three categories:

- Biological – bacteria, viruses and fungi (moulds)
- Physical – foreign objects such as glass wood parts of farm implements
- Chemical – pesticides, heavy metals.

Throughout the food industry the risks of biological hazards occurring far outweigh the risk to consumers from physical hazards which are usually very visible or chemical hazards that may include persistent organic pesticides. These are monitored by a number of environment watchdogs.

Heavy metal analysis was considered for this project but analyses are expensive and sampling is single point-single time. Short term environmental factors will affect results and conclusions would be very difficult to draw from results. Previous reports of heavy metal impacts on public health have been speculative and based on sedimentary and soil analyses (Park, 2013; Maala and Singh, 2008).

The HACCP approach is a major Government initiative especially for industry and tourism. However the process of HACCP implementation in this enterprise is some time away but may become a significant possibility as commercialisation in all areas of public protection increases.
2 THE TRADITIONAL PROCESS

2.1 Untreated Kai

A bulk of the kai is sold, untreated at roadsides or conveniently located market stalls in Viti Levu - Ba, Lautoka, Nadi, Sigatoka, Nausori and Navua and in Vanua Levu – Savusavu and Labassa. They are sold in ‘heaps,’ generally approximating one Kg (often measured using 2 Litre ice-cream containers).

These kai are not suitable for immediate consumption because of the bacterial load (Lowry and Naqasima, 1999; Naqasima 2002; Hatha et al, 2005; Waqalevu, 2015). Although the need for additional treatment is well known within Fiji, self-catering tourists, backpackers and rotating chefs in hotel chains may not be familiar with the risks associated with incorrect treatment.

2.2 Depuration

Prior to consumption, the kai is routinely soaked in water that is changed daily for three days and the resulting detritus discarded at each water change. Quantity of discharged detritus (depurate) is significant for the first 24 hours and subsides during the following days (see Fig 1, Fig 2 and Fig 3). Although changed on a daily basis, longer periods in static water results in a portion of the kai opening indicating physiological deterioration or death. A depuration trial was conducted at Pacific Harbour, the quantity of detritus was observed but not measured because quantity is probably dependent on the location and nature of the river bed and the rate of water flow and other factors that vary so much that conclusions would be fatuous.

In a separate trial water to which 200 parts per million (ppm) sodium meta-bisulfite had been added was used.

Figure 1

Residue Discharged between 0 h and 24
2.3 Shucking

Shucking is the process by which the meat is removed from the shell. This is achieved by heating kai in a portion of boiling water/steam (see Figure 4). As the kai reaches appropriate temperature they open. It is assumed that at this point the kai ceases to be vital. The pH of the kai meat was 6.4 which is a significant factor in keeping quality. As a general rule the lower the pH, the less likely it is to support microbial multiplication.
2.4 Evisceration

Sai Yee Company requires that the kai is eviscerated prior to freezing to meet export specification. The Company permitted use of their factory for training. A small incision is made at the appropriate place on the shucked kai. The viscera is then squeezed out and the eviscerated kai rinsed in water.
The viscera is separated from the meat to avoid cross contamination. The viscera is usually discarded but there was some interest among factory and village members in retaining this viscera for later consumption. The potential of viscera as food was not pursued.

2.5 Freezing

The label on the frozen, shucked kai available in the Fiji retail market gives no indication of the pre-treatment (eg depuration) but it had not been been eviscerated. The method of freezing is also unknown. Good manufacturing practice demands that food is frozen quickly. It is important to cool through the temperature range -0.5°C to -5.5°C as quickly as possible since this causes less damage to the food structure than if it is frozen slowly. Many products throughout the food industry worldwide are blast frozen using very cold air blown across the food at very high speed. Once frozen then international standards (including those for export) require that the food is kept below – 18°C. Fully compliant facilities for export are extremely high cost and demand a high throughput rate to justify capital outlay.

The relative humidity in freezers is very low and loss of moisture from the surface of foods is common (freezer burn). This can be prevented using moisture-proof barriers such as 50 micron polypropylene

Figure 5
Retail Pack of Frozen Shucked Kai

Current labelling in this fashion is unsatisfactory not only because it does not include Codex requirements (Packing Date, ‘Best Before’ Date, Nutritional Panel, Name and Address of Manufacturer, Storage Conditions) but it is most remiss in not detailing instructions for use. This kai may not have been depurated correctly. This information is not available to the consumer.

A Code of Practice has been prepared that includes a description of good manufacturing practice (GMP) mandated for this product. A draft is attached at Appendix 2. It may be a long way from implementation but safety standards are a major target for the Government. The first steps in wider acceptance is submission to the National Codex Committee for deliberation followed by circulation to stakeholders. Some prudence is required during the introduction of regulations. It is important not to impose any element that may quench entrepreneurship.
3 RISK

3.1 Harvest and Depuration

Rivers are susceptible to pollution because of flooding, upstream ablution practices and recreational practices. Because of its filter feeding physiology, kai is a high risk item. It is axiomatic that cause and effect in food-related outbreaks can only be defined with extensive searches for specific genotypes. It is therefore, impossible to quantify the number of cases that have resulted from its consumption. Risk however high from kai because of the range of potentially hazardous bacterial genera known to be present at harvest, delays at each step taken to reach consumption and as a result of contamination during handling.

Although depuration demonstrably removes a high proportion of the bacteria in kai, the removal rate is probably exponential which means that the number of bacteria surviving depuration will depend on the numbers at harvest or during post-harvest storage.

The microbial flora surviving or indeed multiplying during this period is multi-factorial. It is influenced by:

i The microbiological load at harvest.

The decline in numbers of E coli and APC during depuration follows an exponential pattern, hence numbers surviving a mitigating regimen will depend on the numbers originally present. At the same time Waqalevu, (2015) Lowry and Naqasima, 1999; Naqasima 2002; Hatha et al, 2005; Waqalevu, 2015, have pointed out, the initial bacterial load is inexorably linked to the quality of the water from where the kai was harvested.

ii The quality of the water at the harvest location

A number of short term factors will affect water quality. Excessive rainfall affects flooding and feeder water. Pit toilets close to river courses can overflow into rivers and practices such as placing pigpens over rivers can give rise to high levels of contamination. High levels of turbulence caused by storms or floods can increase churning of river beds increasing grit and possibly altering flora that may include anaerobes that are normally confined in low oxygen sediments (eg Clostridium spp, Bacillus spp). These thermophilic organisms form spores that are heat resistant and may survive heating during shucking, freezing and final cooking.

Drought may slow rivers leading to reduced oxygenation and subsequent shift in floral spectrum.

iii Depuration water quality

Water used for depuration is commonly won as rain water or river water. This therefore, is of variable quality. During depuration inorganic matter may be expelled from the kai but this may not necessarily correspond to reduction in bacterial load. Hence there may be a false sense of security about safety during depuration. Even continuous circulation during depuration using high quality water does not necessarily result in totally efficient bacterial removal (Waqalevu, 2015). Furthermore, this equipment is expensive and beyond the financial limit of subsistence villages such as Muana.

The shell and exposed radula are susceptible to contamination from adventitous sources such as sacks, bowls, and kitchen surfaces and – most commonly food handlers. Variations of temperature can result in these surface contaminants being sucked into the flesh in a wet environment. Handling of kai during depuration is a Critical Control Point. Food handling is commonly sub-optimal in villages because
exposure to food hygiene and the concept of ‘bacteria,’ ‘germs’ or ‘microorganisms’ is acquired from school or from very distorted television advertising images.

Training in food handling was identified as a critical requirement during the course of this project and therefore training in the village was an added activity. The training manual is included at Appendix 7.

iv Ratio of kai to depuration water

Assuming that a batch method is used to depurate the kai then the ratio of kai to soak water will have a bearing on the rate of expulsion of both bacteria and inorganic matter. This should be defined if the depuration is to be consistent and there is effective risk management. It is included in the proposed Public Advisory (See Appendix 4).

v Temperature

Kai starts to die after approximately three days after harvest. As a general rule (Arrhenius) biochemical reaction rates double with every 10°C rise in temperature. In the case of kai the ideal metabolic condition correspond to that of the habitat. If the kai is exposed to high temperature, then the rate of deterioration will increase accordingly. Similarly chilling kai will slow deterioration but may result in death below 10°C as respiration enzymes are selectively inhibited. Fluctuations in temperature should be avoided.

These variables prevent the standardisation of depuration at subsistence level. It also leaves tourists and in some cases new chefs unaware of the dangers of using untreated kai

It is suggested that this matter is brought to the attention of the National Codex Committee for consideration about the appropriateness of a national education campaign. The proposed agenda item is included at Appendix 2.

3.2 Shucking, Shelf Life and Freezing

Kai is heated in a boiling water pot. Lower levels of kai actually immersed in water reached 100°C but the temperature in the upper layers reached only 80°C. This is not sufficient for significant bacterial destruction. Hence there will be variation in the bacterial loads of kai shucked in this manner – the lower layers receiving greater heat treatment. Shucked kai has a high pH, high moisture content and high indigenous microbial population some members of which will double their numbers every four minutes. It will spoil and become highly infective extremely quickly and hence must be cooked, chilled or frozen with minimum delay. Chilling merely delays spoilage. For every 10°C drop in temperature the rate of spoilage is halved.

The freezing process is not considered to be exert significant kill on bacteria populations. The Enterobacteriacea and Mycobacteria have robust cell walls and survive freezing with little destruction whereas some of Gram +ve organisms such Staphylococci spp will suffer some destruction so some genera are much more resistant than others (Beyer, 2008 pers res). Hence there will remain a residual bacterial load after shucking and they will still be present once the kai is frozen and thawed. Any biological activity however ceases completely at -18°C which is the upper limit for storage of frozen foods set by Codex.

Hence it is recommended that the labelling instructions include the statements:

‘Store a -18°C prior to use.’

‘Boil for at least 10 minutes prior to consumption.’
These items are pertinent to the Code of Practice (Appendix 3).

3.3 Evisceration

The Sai Yee Company undertook to demonstrate the evisceration technique that was acceptable to their market and Muana team undertook training at the company. The training session was useful because evisceration techniques were demonstrated. However food handling techniques used at the factory are not in concert with those required for HACCP or GMP. Figure 6 demonstrates that protective clothing was not used, jewelry exposed and gloves not used. In addition, doors were left open and provided potential access for vermin.

The session however was used to verify yield of kai meat and eviscerated kai for inclusion in the value chain data enabling an evaluation of the return for effort and an informed decision on future activity.

The price offered for the eviscerated kai was $10.00 per Kg.

3.4 Food Handling

The risk arising out of consumption of inadequately treated kai may be mitigated by standardizing the handling prior to consumption. Cooking in resorts is governed by Hotel and Tourism Code of Practice for Safe Food in the Tourism Industry (Beyer, 2016), however other food outlets may not be as diligent. Risk during kitchen handling is mitigated to some degree by the length of time the kai must be cooked for tenderness. However post-cooking, kai can become infected by cross-contamination with raw kai or other uncooked foods. All foods are particularly at risk if they are kept warm for a significant length of time (lovo, buffets). Fish and kai have relatively high pH values (6.4) which will not inhibit bacterial growth. (By comparison well slaughtered and conditioned meat has a pH value of ~ 5.4 which is a significant factor in keeping quality).

A compulsory Code of Practice similar to that mandated for the Hotel and Tourist establishments is not practical because of the wide range of practitioners, their level of training and the extra costs it may impose to meet standards. Once again the process of change must be incremental to avoid stifling enthusiasm. However a public advisory for broadcast on the social media, the printed media, the television and local radio may be effective at reducing risk – particularly for self-catering tourists and second and third generation urban dwellers who are becoming increasingly divorced from traditional techniques. Such
public awareness monographs are often the domain of the Ministry of Health Food Unit (previously contacted).

It is recommended that a draft ‘Public Advisory,’ containing the elements that allude to correct handling should be submitted to the National Codex Committee for discussion and ultimate action by the Ministry of Health.

A draft is included at Appendix 4.

3.5 Sodium Meta-bisulfite

Sodium metabisulfite (SMS) is a bactericide and is commonly used as a preservative. It is permitted under codex and allowed in the organic food industry to the level of 200 parts per million (ppm). This work has included an investigation of the use of the effect that addition of SMS to the depuration water has on final bacterial load.
4 TRIALS

4.1 Methods

All kai was harvested from the Rewa river adjacent to Muana village.

Experiments

Trial 1 Shell-in kai was transported to Sai Yee Company in Lami with 10 villagers

The kai was shucked and eviscerated.

Samples (x3) of shucked kai and eviscerated kai were transported to the microbiological laboratory at the Institute of Applied Sciences (IAS), USP.

Trial 2 Shell in kai was transported to Pacific Harbour for depuration.

Three samples of kai was depurated in mains water supply at a ratio of one part kai to three parts water. They were depurated for three days and the water was changed every 24 hours. These was shucked and transported to IAS for assessment.

Trial 3 Simultaneously kai was treated in an identical fashion with water to which 200 ppm sodium metabisulfite was added to the depuration water. These were shucked and transported to IAS for assessment.

Trial 4 Mains water from Pacific Harbour was collected and transported to IAS for assessment.

Trial 5 Fishers from Muana village who had previously attended food safety training (See Appendix 5) were transported to KRS with shell-in Kai. There were issued with gloves, protective aprons and hairnets. Kai was shucked and eviscerated in water and sodium metabisulfite in controlled conditions at the Korinivia Research Station, Product Development Laboratory. Conditions are ideal for food processing.

Trial 6 Selected kai eaters (10) were given evaluation forms for an assessment of the difference between depurated shucked kai and eviscerated kai. This trial was not controlled and the kai eaters took kai samples home to assess. They were asked to prepare favourite kai meals with shucked and eviscerated kai and ask family members to complete the evaluation forms given in Appendix

Samples (x3) were taken using sterile technique and transferred to the microbiology laboratory at the Institute of Applied Sciences (IAS) at the University of the South Pacific.

E coli was estimated on kai and its derivatives using the Most Probable Number (MPN) technique ISO 16649-3-2005. The Aerobic Plate Count (APC) was estimated using CO Chapter 6.331. Colony forming units (CFUs) in water were estimated using AP 9215B and E coli using AP 9222G.

In summary the following samples were taken:

Fresh shucked kai with no depuration.
Fresh shucked kai after three days depuration.
Shucked, eviscerated kai with no depuration.
Shucked eviscerated kai after three days depuration.
Depuration water.
Fresh shucked kai rinsed in water containing 200 ppm sulfite.
Shucked kai depurated in tap water containing 200 ppm sulfite.

**Figure 7**

*Hygienic Conditions at Korinivia Research Station*

4.2 **Results**

The levels of *E. coli* and the APCs for fresh and depurated kai are given in Table 1. They are consistent with the previous findings (Lowry and Naqasima, 1999; Naqasima 2002; Hatha et al, 2005; Waqalevu, 2015). The consistency of results is surprising since the water conditions at the time of harvest were not known and may have been quite different.

The microbiological level is reduced significantly after three days of depuration. This is consistent with previous findings. However, as Waqalevu (2015) has pointed out depuration is best conducted under controlled conditions.

The most significant result is the drop in levels of APC’s and *E. coli* as the viscera is removed (Tables 1 and 2). After depuration and evisceration, levels of APC’s and *E. coli* are at negligible levels. The issue then remains to avoid recontamination by poor handling.

A depuration trial was undertaken at Pacific Harrbour to ensure that procedures were followed in timely manner. The tap water at Pacific Harbour may not be representative but during depuration there is a significant drop in APC and *E. coli* levels are low (BDL). It is likely that equilibrium with tap water standards will be reached during three successive water changes – hence the quality of water will affect ultimate bacterial levels (Table 3). Throughout rural Fiji, water is commonly won either from natural sources which can vary or from rainwater which tends to be better quality if collection techniques are maintained.
The reduction in the APC figures using sodium meta-bisulfite is encouraging and may signpost a general reduction in the range of microbiological flora (Table 2). However if there is no further pressing need for its use it should be avoided.

4.3 Discussion

Kai shucked immediately after collection have E. coli and APC levels that do not fall within the Guidelines published by the International Commission on Microbiological Standards in Food (fish and shellfish) Appendix 1.

Kai is not suitable for consumption immediately after harvesting.

Depuration of kai is not undertaken by village members prior to selling at the roadside or in the markets. However these results indicate that it is an essential step in ensuring safety. It is a natural step with which most consumers within Fiji are familiar since it is essential to mitigate the grit content. However for those unfamiliar with kai the importance of this step in reducing bacterial numbers and decreasing risk should be made clear (See Public Advisory - Appendix 3). In addition, traditional knowledge is dwindling among second and third generation urban dwellers who may have come to expect food that is always safe and ready to eat. A public awareness campaign emphasising the correct treatment of kai to this group, self-catering tourists and rotating chefs is mooted (Appendix 3).

Although evisceration is a technique that renders kai safe, the technique is not popular among fishers because it is time consuming and return for effort is obscure. Furthermore, there is anecdotal evidence that the kai loses its taste during depuration. Although this was tested and consumers were asked to compare the taste of shucked kai against eviscerated kai using a nine point Hedonic Scale (Appendix 8) no analyses of the results were undertaken because of preconception and the use of the kai was uncontrolled.

Sodium meta-bisulfite is commonly used in the food industry and although the results here indicate that it reduced numbers the effect is not as significant as that achieved during depuration and evisceration if undertaken. Where addition of food additives is not necessary it should be avoided.
### Table 1

Assessment of the Levels of E. coli and Aerobic Plate Count on Fresh and Depurated Shucked Kai and Fresh and Depurated Eviscerated Kai

<table>
<thead>
<tr>
<th></th>
<th>Fresh Kai Shucked Kai n = 6</th>
<th>Fresh Eviscerated Kai n = 6</th>
<th>Depurated (3 days) Shucked Kai n = 6</th>
<th>Depurated (3 days) Eviscerated n = 46</th>
</tr>
</thead>
<tbody>
<tr>
<td>E coli</td>
<td>mean range</td>
<td>mean range</td>
<td>mean range</td>
<td>mean range</td>
</tr>
<tr>
<td></td>
<td>330 305-400</td>
<td>10^4-10^5</td>
<td>&lt;20 490 330-505</td>
<td>&lt;20 330 &lt;20</td>
</tr>
<tr>
<td>APC</td>
<td></td>
<td>10^2-10^5</td>
<td>&lt;20</td>
<td>&lt;20</td>
</tr>
</tbody>
</table>

### Table 2

Assessment of the Effects of 200 ppm Meta-bisulfite Addition

<table>
<thead>
<tr>
<th></th>
<th>Fresh Kai Shucked Kai n = 6</th>
<th>Fresh Eviscerated Kai n = 6</th>
<th>Depurated in sulfate (3 days) Shucked Kai Sulfite treated n = 6</th>
<th>Depurated in sulfate (3 days) Eviscerated n = 46</th>
</tr>
</thead>
<tbody>
<tr>
<td>E coli</td>
<td>mean range</td>
<td>mean range</td>
<td>mean range</td>
<td>mean range</td>
</tr>
<tr>
<td></td>
<td>330 220-488</td>
<td>10^5-10^6</td>
<td>&lt;20 7.7x10^3</td>
<td>&lt;20</td>
</tr>
<tr>
<td>APC</td>
<td></td>
<td>10^2-10^5</td>
<td>&lt;20 5.5-9.0x10^3</td>
<td>&lt;20</td>
</tr>
</tbody>
</table>

### Table 3

Depuration Water Quality (Pacific Harbour)

<table>
<thead>
<tr>
<th></th>
<th>Heterotrophic plate count</th>
<th>E coli</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 est</td>
<td>&gt;1</td>
</tr>
</tbody>
</table>
4.4 Conclusions

1. Shell-in kai for sale does not conform to levels mandated by Codex or the ICMSF.

2. Depuration for three days will reduce bacterial levels but the efficiency or bacterial removal is dependent on:
   - The microbiological load at harvest.
   - The quality of the water at the harvest location
   - Depuration water quality
   - Ratio of kai to depuration water
   - Temperature.

3. Depuration is time consuming and not normally the domain of the fishers except for home consumption when (anecdotally) kai depuration may be as short as one day. However this is for immediate cooking and consumption during which risk is low.

4. Correct techniques for depuration are institutionally known in Fiji but not necessarily by the certain consumer groups. An awareness campaigns through a ‘Public Advisory,’ is recommended to cover these sectors.

5. Large scale automatic depuration devices such as that described by Waqalevu (2015) may be practical but would require a significant throughput rate for cost-effectiveness and hence some degree of cooperation among producers is advised.

6. For processed kai, Codex demands that there is traceability in the food sector and a this should be the subject of discussion at upcoming National Codex Committee meetings. A draft Code of Practice has been prepared for discussion and is included in Appendix 2.

7. Sai Yee Company is not an appropriate partner in the commercialisation of kai because internal handling techniques are not satisfactory and the price offered for eviscerated kai does not provide adequate return for effort for fishers.

8. Evisceration is a technique that ensures rapid removal of bacteria normally included in the APC technique and *E. coli* to the level that conforms to standards cited above.

9. Evisceration removes the requirement for depuration.

10. The evisceration technique is not popular among fishers given the current market acceptability of shucked kai.

11. The effects of adding sulfite were insignificant and so unnecessary use of this preservative was not pursued.
4.5 Significant Outcomes

Muana kai harvesters are aware of a number of options they have for adding value to kai.
Muana kai harvesters have been made aware of the elements in the value chain which are given here.
Muana villages have received training in food handling.

Combining this study with previous studies, it has become where risks is greatest along the supply chain which will pave the way for controlling the critical points (HACCP) in line with Government imperatives.

Urbanisation is increasing in Fiji and many second and third generation urban dwellers are becoming increasingly divorced from traditional practices.

Now that the critical risk points where control should be focused have been identified, it is important that the populace at large are made aware of the steps that should be taken to reduce risk. The key elements of such public awareness have been drafted (Appendix 4).

It is important that value adding and entrepreneurship are not stifled but simple changes in the manufacture of frozen kai may be necessary. The current method of labelling and packaging is not satisfactory. A Code of Practice for the frozen kai industry has been drafted and included here.

Removal of doubt about the safety of kai will be a significant advantage in any future marketing bids.
Critical to the sustainability of the project is the return for effort. To evaluate this, losses at each stage in the chain were quantified. To this the theoretical increase in value was assigned. This is not a value chain analysis because issues such as transport and labour costs have not been included. Should the product from each step be offered for sale then a guide to its market value can be assumed using a technique that is commonly used in the food industry. The raw material cost is multiplied by three. This is demonstrated in detail in Section can then be a guide to its market value. From this, the return for effort can be defined and the practitioners can be make informed decisions about likely market penetration and competitiveness.

5.1 The Value Chain

This assumes that the mass of a sack of kai is 50 Kg and that the price is $70.00.

The return for a 50 Kg bag of in-shell kai is $70.00. This weight is estimated by volume by the fishers. There were no facilities for verifying this value but the single bag of kai transported to Sai Yee Company was 70.83 Kg (including the bag) ($1.40)

At the roadside the kai is sold in heaps and the quantity is measured using a 2 Litre ice-cream container. Eleven samples of kai were weighed and the mean weight (average) of the 11 samples was 984g ranging from 888g to 1109g (range 221g).

The $3.00 prices were consistent throughout Suva, Navua markets and the Korinivia roadside site. The roadside value for chain purposes is $3.00 /Kg.

5.1.1 Depuration

Seven samples of 30 shell-in kai were weighed before and after depuration for three days in tap water. There was no detectable difference in weight during this period.

5.1.2 Shucking

Weight loss was measured on seven samples of kai in addition to the three trial samples (Sai Yee Co and KRS). The mean (average) weight loss during meat removal was 29.19% and ranging from 27.01% to 31.44% (range 4.43%). Hence the value of shucked kai is $4.38.

The margin between harvest and shucking is $2.98.
Margin between depuration and shucking $1.38 / Kg.

5.1.3 Freezing

This product is intermittently available in supermarkets and retails at $7.29 for 500g (the supermarket markup is 30% so the return to the processor is $5.10 per Kg)

5.1.4 Eviscerating

Weight loss was measured on five samples of kai. The mean (average) weight loss was 22.5% ranging from 22.01% to 23.9% (range 1.8%). Hence the value of the eviscerate kai $5.66.

The margin between harvest and eviscerated kai is $4.26
The margin between shucking and eviscerating is $1.28.

(Note: Sai Yee Co offered $10.00 /Kg).
Figure 8
VALUE CHAIN KAI PRODUCTS

HARVEST
$70.00 per 50 Kg Sack
$1.40 per Kg (Shell in)

ROADSIDE AND MARKET SALES
$3.00 per Kg

DEPURATION
$1.40 per Kg

PERSONAL CONSUMPTION

SHUCKING
$4.28

Eviscerating
$5.66 per Kg
MARKET PRICE $16.98

PACKAGING

FREEZING

RETAIL SALE
$14.58 per Kg
In the context of commercialization, depuration is time-consuming labour-intensive and may not achieve the safety targets expected.

Safety is much more likely if the kai is eviscerated.

5.1.5 Estimating Return for Effort

For industrial processing a generalized rule is used to establish processing costs especially while deciding viability prior to investment. Normally the raw material cost is multiplied by three and this factor covers labour, services and rentals for small volume production. The result of this is guide to the cost at the point of dispatch. Hence the shucked, frozen kai should leave the processing centre at (3 x $4.28) $12.84. Commonly supermarkets’ margins are approximately 30% so that the retail price should be of the order of $16.70. The retail sale price of $14.58 is very competitive and may indicate that labour is inexpensive or other financial cuts have been made.

Eviscerated kai should be leaving the processing centre at (3 x $5.66) $17.00. This compares favourably with current shellfish prices offered by resorts (scallops $28.00 and giant clams $47.00). Eviscerated kai has the advantage that it is a Fiji product.

5.2 Value Adding

Value adding frequently involves increasing convenience. The urban population of Fiji is 52%. This sector has little time or access to kai. Hence this represents a significant market opportunity. The return for high value ingredients in convenience foods is offset by ‘dilution,’ with less expensive co.ingredients – a stratagem frequently used to increase return for effort.

Kai is an ideal raw-material base to which value can be added.

Depurated, shucked kai has a distinctive flavor which persists throughout additional processing. A plethora of sauces and garnishes can be added (curry, ginger-soy) which add variety but which retain distinctive flavours.

Figure 9

Kai ‘Diluted,’ with Less Expensive Ingredients
However professional food handling techniques are required on culinary completion. Kai products have the advantage that they are scarce on the market and hence have the novelty advantage – especially important in the tourism industry where there is a scarcity of uniquely Fijian produce.

The tourism industry is the subject of major promotions by the Fiji Government particularly with the emphasis on increasing consumption of local foods. Kai has the advantages that it is locally harvested and – with appropriate marketing comes with an exotic genre. For chefs for whom maintaining their input into their cuisine, safe shucked kai is a local exotic choice.

5.2 Conclusions

1. Shell-in kai sold at the roadside offers lower return for effort compared to depurated shucked kai.
2. Shucked kai is an enormously valuable product for in-depth processing because of the returns for effort it commands but also in the provision of an exotic new product for the tourism sector.
3. There appears to be little extra return for effort resulting from the evisceration process.
4. In free-flow frozen form kai becomes a direct competitor with imported green lipped mussels but has the advantage that it is grown and processed in Fiji.
5. There are endless possibilities for on-processing into ready-to-eat meals – a market sector that is increasing with increasing urbanization.
6. A significant hurdle is that shucking and other processing enterprises will require facilities and equipment that will enable conformation to regulations and standards.
The choice of Muana village as the centre of the series of studies on kai has been described (Waqalevu, 2015). This village is operating at subsistence level with fishers collecting for four to five hours a day perhaps four days a week. A fair portion of time is spent at the roadside selling whole kai.

During this study ten ladies were active participants and pleasingly two gentlemen attended the training sessions but were not fishers. It is disturbing to note that the average age of the fishers is of the order of late 50 - 60s occasionally joined by a couple of teenage boys. Furthermore, as Waqalevu (2015) has pointed out, ‘The fishers surveyed mentioned that there are noticeably lesser fishers now involved in the fishery as compared to 20 years ago. The fishers mentioned that better education and greater employment opportunities provide an easier way of getting money.’

The danger of leaving this situation without future intervention is that the enterprise may decline below critical limit. This is disappointing since kai is a high value product which is an ideal base for value adding and with enormous potential to provide rural income and to make a contribution to food security.

Although assistance to small-scale subsistence operators is not out of the question, it is rare and difficult to achieve. However cooperation among the three villages in the Tikina of Toga may assist if the fishery were to expand even beyond this district. The prospect of eviscerating for the Sai Yee Company has been abandoned because the return for effort is unacceptable so the pursuit for assistance must be made by harvesters of kai.

However, the Hotel and Tourism Association are adamant that they would encourage the use of kai in the hospitality industry if (Discussions Beyer/Wong/Gillespie):

- They were presented in a convenient form (shucked in 5 Kg frozen free flow pack).
- There was a guarantee of safety (FHTA CoP: perhaps HACCP Certified – conforming to Codex Standards)
- There was sufficient for continuous use (Est 20 Tonnes per annum).

They further asserted that the price that would be paid for such product with such guarantees would be guided by the import price currently paid for frozen shell-in green lipped mussels (equivalent to $FJD 28 /Kg for meat). Once production is established the market can be extended to urban centres where 85% of the population now live.

The product range could be augmented to include:

i Free-flow frozen shucked kai.

ii Convenience whole meals (curry, soy-ginger etc) in single portion packs for the retail market.

iii Kai burger patties.

---

1 Michael Wong – CEO Fiji Hotel and Tourism Association (FHTA); Michael Gillespie – Chief of Operations: Tanoa Group of Hotels.
This is on the premise that the area currently used as a serving point during special occasions is refurbished for food production. The facilities should be upgraded to those standards outlined in the CoP Annexure 2 Page 32. The minimum equipment requirements are suggested in Appendix 6.

Discussions with Andrew Goulding\(^2\) has indicated that the cost of this refurbishment of the village hall will be approximately $30,000 including appropriate waste facilities.

In addition, there will be an equipment costs which have been sourced from Food Machinery Australia subsidiary Food Manufacture Australia (FMA); Weldfab (NZ) Ltd (weldfab@xtra.co.nz). These are likely to exceed $70,000 (Appendix 8).

It would be optimistic to imagine that granting for one village would be successful. The chances are greater with a greater number of potential beneficiaries.

Hence a more optimistic strategy would be to solicit support from a far greater raw material base. Not only would this mean that throughput rates would be high – which reduces production costs per item but also that a larger interest group become potential sources of funding assistance. Combining effort with other villages, Vunisei and Navatuyaba for instance my add momentum that may command investment from within Fiji or through the common funding agencies (See Sectionn 5). The advantages of cooperation among a wider group encompassing the entire Rewa and Tailevu region are discussed. Cooperation involving a greater number of beneficiaries always assists in the quest for aid.

It is possible that the model used for the quality aspects and distribution could be handled using the successful model created for the papaya industry – Nature’s Way Cooperative. In this model, those supplying the facility take a vested shareholding in the ‘business.’ Hence all realized profits are returned to the harvesters (fishers) the processing takes place in a single, controlled, HACCP-compliant processing plant. Distribution and quality maintenance are tasks undertaken leaving the production responsibility to the producers.

**It is recommended that a feasibility study is undertaken to assert if there is significant will among the eastern Provinces to establish cooperation and hence movement towards a formalization of the industry.**

**The Terms of Reference to be defined after consultations with all interest groups including the fishers, Provincial Council, The Ministry of Youth and Sport, the Ministry of Trade, the Ministry of Health and the Ministry of Women and Poverty Alleviation.**

---

\(^2\) Andrew Goulding – private contractor and former Projects Manager JS Hill
APPENDIX 1

BACTERIAL STANDARDS FOR FISH PRODUCTS

Table 4.1. Sampling plan and recommended microbiological limits for seafood (ICMSF 1986).

<table>
<thead>
<tr>
<th>Product</th>
<th>Test</th>
<th>Case</th>
<th>Plan Class</th>
<th>n</th>
<th>c</th>
<th>m</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh and frozen fish; cold smoked fish</td>
<td>APC</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>5×10^4</td>
<td>10^5</td>
</tr>
<tr>
<td>Precooked breaded fish</td>
<td>E. coli</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>11</td>
<td>500</td>
</tr>
<tr>
<td>Fish</td>
<td>E. coli</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>5×10^4</td>
<td>10^5</td>
</tr>
<tr>
<td>Frozen raw crustaceans</td>
<td>APC</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>10^6</td>
<td>10^5</td>
</tr>
<tr>
<td>Frozen cooked crustaceans</td>
<td>E. coli</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>11</td>
<td>500</td>
</tr>
<tr>
<td>Cooked, chilled, and frozen crabmeat</td>
<td>APC</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>5×10^4</td>
<td>10^5</td>
</tr>
<tr>
<td>Fresh and frozen bivalve molluscs</td>
<td>APC</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>10^1</td>
<td>-</td>
</tr>
<tr>
<td>S. aureus</td>
<td>9</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>10^1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1) APC = Aerobic Plate Count (preferably carried out at 21–25°C on a nutrient rich, non-selective agar.

n = number of samples (determined by the Codex standards sampling plan – Plan Class 3)

c = maximum allowable defective units

m = acceptable microbial maximum in a sample
APPENDIX 2

NATIONAL CODEX COMMITTEE

AGENDA ITEM
KAI (Batissa violacea)

Introduction

1. Kai is a traditional food item harvested from all the major rivers in Fiji. Previous work (Lowry and Naqasima, 1999; Naqasima 2002; Waqalevu, 2015, Beyer, 2016) has indicated that raw kai microbiological levels do not conform to international standards.

2. Outbreaks of typhoid have indeed been linked to untimely kai consumption.

3. While there is institutional and widespread traditional knowledge about the requirement to soak (depurate) kai for three days in fresh water, increasing visitor numbers and the increasing employment of overseas chefs may not have the same familiarity with this technique.

4. Codex mandates that food is traceable and that it must be possible to trace the source of any mishaps relating to food intoxication.

5. Unlike fresh fruits and vegetables which are ready for immediate cooking and consumption, kai is not.

6. The NCC is invited to discuss the most appropriate method of broadcasting to the users of kai the optimum method of treating kai prior to consumption.

7. The NCC is invited to discuss the most appropriate means of tracing kai back to its origins in the event of a food-related incident so that causative agents can be quarantined to prevent spread of any outbreak.

8. Any action suggested must take into account that there is usually a financial imperative on fishers and that written instructions may not be the optimum means of communication.
APPENDIX 3
DRAFT

CODE OF PRACTICE (COP) FOR THE PREPARATION OF KAI FOR PUBLIC CONSUMPTION

Introduction

Fiji is a member of the World Trade Organisation and as such has an obligation to mandate and enforce the standards, Codes of Practice and Recommendations enshrined in Codex Alimentarius. The instruments by which Fiji enforces these standards are through the Food Safety Bill (2002) the Food Safety Bill (2003) and the Food Regulations (2009) through the National Codex Committee.

The spirit of the Food Regulations is to reduce the likelihood that hazards are present in food and that the risk associated with these hazards are reduced to a minimum by a close examination of the critical points in a food process. Formally food preparation outlets, restaurants, hotels, cafes and factories are required to implement the system – HACCP.

Realistically this significantly confounds entrepreneurship. Hence the process may be delayed but the inspection authorities are tolerant provided that progress is continuous and continuing. This is recognized in this CoP by including the standard for idealized production facilities (Annexure 1) and those that are undergoing modernization or refurbishment Annexure 2).

Raw Kai

Kai will be harvested from reputable sites commonly used for fishing. Every effort will be made to keep kai alive by storing in a cool moist environment.

Kai intended for sale at municipal or roadside markets will kept in shady, damp conditions. Kai that is not sold will be retrieved and placed in cold potable (town) water for resale or home use. The water will be discarded. This kai may be re-offered for sale the following day and, if unsold it will be retrieved and re-soaked after market closure. This may be repeated one final time.

No kai that has been harvested a maximum of three days may not be offered for sale.

Optimum post-sale treatment (depuration) will be the subject of a public advisory campaign.

Frozen Kai

It is mandatory (Fiji Food Regulations; 2009) that food processing takes place in premises that provide the best possible protection for consumers.

The conditions of preparation areas are ideally those given in Annexure 1 of this COP. For entrepreneurs that have existing premises, upgrading can be staged to suit financial imperatives but have been prioritized in Annexure 2 to this CoP.

Kai must be depurated prior to entry into the processing premises.
Kai is opened by heating in a boiling container until shell-opening. They are removed from their shells and the shells are discarded outside the production area for removal no longer than 24 hours after processing.

The kai will be cooled and packed in appropriate, sealed containers with single or multi-layered plastic containing one element of which that exceeds 50 micron polypropylene.

It will be frozen to a maximum temperature of least -18°C.

The package will be labelled with the following items:

Name of the product,
Statement of weight or number
Name and address of manufacturer
Packing date
Use by date (in the case of frozen shellfish this is 6 months after packing date)
Storage conditions - ‘Store below -18°C’
After opening consume within 24 hours – do not refreeze.
Instructions for use (eg this product is intended for use in the preparation of ready-to-eat dishes and requires additional cooking
Nutritional Panel (Not universally required)
Bar Code

Ready-to-eat Convenience Dishes

The conditions of preparation areas are ideally those given in Annexure 1 of this COP. For entrepreneurs that have existing premises, upgrading can be staged to suit financial imperatives but have been prioritized in Annexure 2 to this CoP.

Kai must be depurated prior to entry into the processing premises.

Kai is opened by heating in a boiling container until shell-opening. They are removed from their shells and the shells are discarded outside the production area for removal no longer than 24 hours after processing.

The kai is used for further processing, it must be stored chilled (3°C – 9°C) for no longer than 24 hours.

The remaining ingredients are added and cooked. For most convenience it is cooked for sufficient time to tenderize the kai.

The kai will be cooled and packed in appropriate, sealed containers with single or multi-layered plastic containing one element of which that exceeds 50 micron polypropylene.

The package will be labelled with the following items:

Name of the product,
Statement of weight or number
Ingredients in descending order.
Name and address of manufacturer
Packing date
Use by date (in the case of frozen shellfish this is 6 months after packing date)
Storage conditions - ‘Store below -18°C’
After opening consume within 24 hours – do not refreeze.
Instructions for use (eg this product is intended for use in the preparation of ready-to-eat dishes and requires additional cooking).
Nutritional panel (Not universally required - where required)
Bar Code

**Annexure 1**

**Introduction**

**New Facility Requirements**

Where new premises are proposed, consideration facilities should be located, designed and constructed to ensure that:

- conditions should be satisfied where necessary to protect the safety and suitability of food: the surfaces of walls, partitions and floors should be made of impervious materials with no toxic effect in intended use;
- walls and partitions should have a smooth surface up to a height appropriate to the operation;
- junctions at walls and floors should be coved with inert material with a diameter of 0.6 cm.
- floors should be constructed to allow adequate drainage and cleaning and there should be no pooling of water;
- ceilings and overhead fixtures should be constructed and finished to minimize the buildup of dirt and condensation, and the shedding of particles and all electrical fittings to be water-proof so that the entire premises can be hosed;
- windows should be easy to clean, be constructed to minimize the buildup of dirt and where necessary, be fitted with removable and cleanable insect-proof screens. Where necessary, windows should be fixed;
- doors should have smooth, non-absorbent surfaces, and be easy to clean and, where necessary, disinfect;
- working surfaces that come into direct contact with food should be in sound condition, durable and easy to clean, maintain and disinfect. They should be made of smooth, non-absorbent materials, and inert to the food, to detergents and disinfectants under normal operating conditions.
- staff facilities should be such that changing clothing is possible in private and washing facilities are available;
- design and layout permit appropriate maintenance, cleaning and disinfections and minimize airborne contamination;
- the layout should be such that prepared food is placed on a servery from which front of house staff can collect dishes without entry into the primary production area;
- surfaces and materials, in particular those in contact with food, are non-toxic in intended use and, where necessary, suitably durable, and easy to maintain and clean;
- there is sufficient hard standing for delivery vehicles to unload and or gross soiling to be removed prior to further handling;
- doors must be self-closing and there must be at least two self-closing doors between the primary production area and toilets;
• where appropriate, suitable facilities are available for temperature, humidity and other controls;
• there is effective protection against dust, fumes and smoke, and,
• there is effective protection against vermin access and harbourage.

Annexure 2

Existing Facilities for Refurbishment -Priority Requirements

In the case of established hospitality outlets where redesign is not possible then additional works should be programed so that they incorporate the features listed above. However the following priorities are ranked.

- conditions should be satisfied where necessary to protect the safety and suitability of food: the surfaces of walls, partitions and floors should be made of impervious materials with no toxic effect in intended use;
- walls and partitions should have a smooth surface up to a height appropriate to the operation;
- floors should be constructed to allow adequate drainage and cleaning;
- ceilings and overhead fixtures should be constructed and finished to minimize the buildup of dirt and condensation, and the shedding of particles and all electrical fittings to be water-proof so that the entire premises can be hosed;
- windows should be easy to clean, be constructed to minimize the buildup of hazards and where necessary, be fitted with removable and cleanable insect-proof screens. Where necessary, windows should be fixed;
- doors should have smooth, non-absorbent surfaces, and be easy to clean and, where necessary, disinfect;
- doors must be self-closing and there must be at least two self-closing doors between the primary production area and toilets;
- wall and floor junctions should be coved with a radius of 0.7cm.
- working surfaces that come into direct contact with food should be in sound condition, durable and easy to clean, maintain and disinfect. They should be made of smooth, non-absorbent materials, and inert to the food, to detergents and disinfectants under normal operating conditions.
- cooking points should be covered with extractor fans with easily removed filters for cleaning,
- staff facilities should be such that changing clothing is possible in private and washing facilities are available, and,

Annexure 3

Code of Practice

Hand Washing

Step 1 – Clean under each fingernail using warm running water, antibacterial soap and a nail brush
Step 2 – Wash hands with warm running water and antibacterial soap, rubbing well (front, back and between fingers) for at least 30 seconds.

Step 3 – Dry hands thoroughly with single use paper towel or hot air dryer.

M = level that must not be exceeded in any sample. If exceeded the entire consignment is to be rejected.
PUBLIC ADVISORY
(Ministry of Health)

THE SHELLFISH KAI IS TAKEN FROM FIJI’S RIVERS

WITHOUT TREATMENT THE BACTERIAL LEVEL MAY BE HIGH AND THE KAI GRITTY

IN ITS RAW STATE KAI STRAIGHT FROM THE RIVER MAY CAUSE SICKNESS

IT IS IMPORTANT TO SOAK KAI IN THREE TIMES THE VOLUME OF TAP WATER AND CHANGE THAT WATER EVERYDAY FOR THREE DAYS

ONCE OPENED THE KAI CAN BE USED FOR COOKING

COOKING SHOULD NOT BE DELAYED UNLESS THE KAI IS REFRIGERATED

CONTACT BETWEEN COOKED KAI AND KNIVES AND BOARDS AND SURFACES THAT HAVE BEEN USED FOR RAW KAI MUST NOT OCCUR

ONCE KAI IS TENDER FOR EATING IT IS SAFE TO EAT
APPENDIX 5

IMPROVING LIVELIHOODS OF RURAL COMMUNITIES BY INCREASING ECONOMIC BENEFITS FROM THE FIJI KAI FISHERY BY ADDRESSING FOOD SAFETY ISSUES

FOOD HANDLING TRAINING

MUANA VILLAGE

11TH MARCH 2016

Richard Beyer
FOOD HANDLING

1.1 Introduction

Our food comes from the soil (as vegetables and some fruits) from trees (such as nuts and fruits like mangoes and pawpaw) and from farmed animals (such as chickens, cattle and pigs) or that are caught hunted (such as fish and pigeons) other foods come from animals such as eggs and milk.

Some of the foods are seeds which can be kept from one growing season to another. These foods are nuts, and cereals such as rice and wheat. They will keep well if they are kept dry and very well if they are kept cool and dry.

But most of the foods consumed in Fiji spoil very quickly - especially at the high temperatures that are found in tropical countries such as those found in Fiji. They spoil for two reasons:

- The life processes may continue (fruits and vegetables continue to ripen and then over-ripen).
- They are attacked by life forms that are too small for us to see – microorganisms (lit little life) (germs) viruses or moulds.

1.1.1 Life and Death Processes within Food

All life forms go through a period of growth, maturity and ultimately decay and death. Bananas are good examples. They grow on the tree, are commonly picked almost green, turn yellow as we keep them and eventually turn soft and black during tissue death.

These processes can be slowed or even stopped in some foods by chilling or by packing them in a special gas. Tomatoes that come from overseas are chilled as they are transported to Rarotonga and this slows down the life processes so that they are in good condition when they reach the island.

Apples and pears are now kept in good condition all year round by chilling and packing them in special gas mixtures that stop them dying.

We are fairly lucky with kai because it will continue to live if it is kept in fresh water and they will not age.

1.1.2 Attack by Microorganisms (Germs)

All around us there are very small life forms, which are much too small to see. They are present in very large numbers and there are many different types. They are called germs or more often - bacteria, viruses and fungi - microorganisms.

Some of these microorganisms will grow at high temperatures some at very low temperatures. Some will grow only in air and some will grow only where air is not present. Some are so tough that they are not killed by boiling water.

Bacteria survive well in warm humid conditions. Light does not make a difference so that they grow during the day and in the night or in dark places.
Places bacteria are found in very big numbers are in:

- soil
- animal droppings
- human droppings (feces)
- dirty water
- rotten food
- human nose and throat
- hair and all body fluids
- all animals

Although many substances may start off without any bacteria on them (what we call **sterile**) bacteria can quickly get onto them (that is they become **contaminated**) - especially if they are exposed to the elements listed above.

**Figure 1** E coli - A Common Food Illness Bacterium (each cell is a millionth of a metre long)

Although some germs cause sickness, most bacteria are harmless and do not cause illness. However very large numbers of bacteria on foods mean that they spoil very quickly. The speed at which foods spoil is dependent on the number and types of bacteria present and the conditions under which the food is stored. It is the food processor and handlers responsibilities to make sure that foods that we prepare for others to eat have the lowest numbers of bacteria as possible.

Some bacteria do cause sickness. Not only must we have a responsible attitude toward the welfare of others, but also if our food products cause illness then this is very serious for the future of our food producing activities because others (consumers) will not eat our food again.
Kai feeds by filtering large volumes of water to obtain any nutrients (foods) in the water. Unfortunately these nutrients often include some of the dangerous germs listed above.

1.2 Bacteria that can cause sickness

There are many ways in which food can become contaminated with dangerous bacteria

1.2.1 Contamination from the equipment

Some foods are always contaminated because of the ways in which they are produced. All vegetables that come out of the soil for instance are contaminated with bacteria from the soil. Some bacteria from the soil will cause sickness (pathogenic). Many pathogenic bacteria found in soil ultimately come from the droppings of animals but others are naturally present in soil, water and especially the mud at the bottom of rivers.

Fruits and tree crops may be contaminated with bird droppings or from soil blown onto them as dust.

Foods derived from animals are contaminated with bacteria from the field or from their feces or from their guts. Although the muscle of meat and fish itself may be sterile (free of bacteria), it can become contaminated by using knives that have cut the guts and then the meat. In addition, contaminated food such as guts or skin when placed onto a table or cutting board contaminates that the table or cutting board.

The same happens with fruits and vegetables. Our products may start off being sterile but if it is put onto a table that has been used to cut raw fruit then they will become contaminated.

During transport from the field or garden to the inside of our production area then our shoes and feet will bring bacteria into the food preparation area. This is worse in fruit or vegetable processing areas because they come in with soil on them. In addition, workers moving in and out bring soil and therefore bacteria into the preparation area.

Rule 1 Food arriving at the processing area must be washed before it enters the processing area and any food that falls on the floor is contaminated and cannot be eaten without either washing carefully or reprocessing.

Food (and peeling and trimmings) that is dropped on the floor also attracts insects, birds, rats, mice and cockroaches (vermin). All of these animals may walk through soil or feces and then over tables and will then transfer bacteria from soil and animal droppings to the table and then to the food and our hands.

Rule 2 Any food, peelings or trimmings that fall on the floor must be removed immediately so that vermin (rats, mice, birds, insects, cats or dogs) will not be attracted to want the food production area.

Rule 3 Dirty areas such as around the vegetable or fruit washing area and the entrances should be washed regularly.

Rule 4 Waste food should be discarded at an area remote from the processing area so as not to attract vermin. (Wherever possible vegetable waste should be composted).
Rule 5 Movement in and out of the production area should be restricted to those staff who have undergone training in food hygiene and handling. Where possible all access doors should be self closing to prevent vermin from entering the food processing area. Access to people not involved in food processing should be prohibited.

Rule 6 All foods components including additives should be kept in sealable containers so that insects, birds, rats and mice will not be attracted to them.

1.2.2 Contamination from Handlers

Factory staff will bring bacteria into the factory on their shoes and feet. But we are all carriers of bacteria in addition to those that we have picked up on our feet. We carry bacteria on our hands from everything we have touched. Many are naturally present and we are unable to stop them growing and we have them on our skins, hair and in our intestines. They may not show any symptoms of illness on us but are able to cause sickness in others. Hand washing and showering and foot baths assist in preventing contamination but protective clothing including mask, hairnets, gloves, clean overalls and foot-ware are now essential in many advanced food processing facilities.

So if we have just stroked a dog or cat then we will have many bacteria on our hands because all animals are heavily contaminated with bacteria.

We may have been to the toilet and not washed our hands afterwards. Remember that feces and also the areas around our bodies that are near to the toilet areas are heavily contaminated with bacteria unless we take a shower every time we use the toilet. This is not possible. Bacteria can get through eight layers of toilet paper and so if we use the toilet we have many, many bacteria on our hands.

**Rule 6 Hands must be washed using soap and water after using the toilet – EVERY TIME.**

Sometimes there is only one very dirty towel that may have been used by many others. They may not have washed their hands very well after using the toilet. **Do not use it.** Shake your hands dry and don’t touch anything else before handling food. If possible taps should be foot or knee operated.

It is the custom in PICs to shake hands regularly with friends and people we know. They may have used the toilet and not washed their hands. We may have touched a wooden handle, which has been touched by many others who have not washed their hands. We may have slipped and put our hands on the ground which – as we know has many many bacteria.
Rule 7 Hairnets, gloves coveralls and waterproof footwear is mandatory in the processing area

Although we carry many bacteria, most of the time they do not affect us. But bacteria belonging to one person may cause sickness in another person. These bacteria can be transferred to others by sneezing, when hair falls out and when we touch. There are many bacteria around our noses and throat. If we touch our nose or mouth then we will have bacteria on our hands, which can cause sickness in others. Smoking is also not allowed in food factories because the bacteria from our noses and mouth are transferred onto our hands – again after smoking we must wash our hands. Cigarette ends are heavily contaminated with bacteria and they are unsightly.

Rule 8. Hands must be washed as you re-enter the food production area especially after smoking, using the toilet, eating or nose-blowing or sneezing into a handkerchief.
The same rule applied to eating within the factory because as we put food in our mouths or lick our fingers then those bacteria in our nose or throat are moved to our fingers. It is important that we wash our hands after eating. Because we may spill food on the floor (see Rule 2) then we must never eat in the factory areas. Jewelry should be removed or taped using surgical protective tape to ensure that bacteria behind the item does not contaminate food and that it does not fall into food processing equipment. Protective clothing should have pockets on the inside so that the contents of pockets (pens etc) cannot drop into the food.

If finances permit protective clothing should be provided that is changed and washed every day. Gloves and hair nets are essential.

**Rule 9 Smoking, chewing, eating and spitting are not permitted in the processing area. When taste testing foods, utensils used for tasting must not be returned to the food under preparation.**

Sneezing will spread bacteria from our nose over a wide area and if we feel that we are about to sneeze we should move away from the food production area quickly or catch the sneeze aerosol (spray) in a tissue or a handkerchief. The tissue must be discarded. Immediately after sneezing we must wash our hands before touching food or anything else.

**Rule 10 We never sneeze onto food and if we sneeze into a tissue it is thrown away immediately and if into a handkerchief we must wash our hands immediately.**

If we have a boil or sore on our bodies, it is full of bacteria, which will certainly cause illness in others. It must be covered with a dressing in such a way that it cannot leak. If this is not possible, then your tasks for the day must **not** be anywhere near food.

If you have a running tummy, then you should not enter the factory and should stay at home. If it is only a mild case then you should tell your supervisor who will give you tasks away from food.

**Rule 11 Any symptoms of illness including colds, ‘flu or boils or other skin lesions must be reported to the supervisor.**

**Rule 12 Staff incurring injuries that result in bleeding must be treated for emergency and removed from the processing area as quickly as possible consistent with safe First Aid practices.**

1.3 **Microorganisms that can Cause Damage to the Food Itself - Spoilage**

Not all bacteria will cause illness. But any food that we eat, can also be used by bacteria. When bacteria use food they make chemicals which may be sour or which may smell bad. If we leave meat, fish or milk out of the fridge it starts to smell very quickly. This process is called **spoilage**.
We can stop spoilage by any one of the following methods:

- Freezing
- Packing in a can (or more recently heat-resistant plastic containers) and heating it so that all the bacteria are killed (canning, retort pouching)
- Drying

Foods preserved this way will keep for a long time (up to 2 years)

We can slow down spoilage by:

- Cooling in the fridge.
- Salting.
- Storing in vinegar (pickling).
- Adding sugar (jam, and crystallised fruits and ginger).
- Adding a preservative.

Foods preserved this way will keep for a short time only. The rate of spoilage slows to half every 10°C drop in temperature so foods kept at room temperature ~ 25°C will spoil about four times more quickly than foods stored in the ‘fridge at 5°C.

The time that these foods keep will depend on how many bacteria are present at the time we finish processing them.

It is very important for our food items that we try very hard to keep bacteria out. So, in addition to washing our hands every chance we get, we must also make sure that we look after the food at every stage of the process.

That means that we wash every surface that the food touches. Our tables and scales must be cleaned so carefully that we can see no dirt on them. Our knives have to be clean. We must make sure that no dirt from splashed hoses can touch our food. At the end of the shift we must work on a cleaning system that makes sure that bacteria cannot grow overnight.

If household bleach (eg Chlorox) is diluted 20 parts water to 1 part bleach, it makes an excellent rinsing solution so it can be used to sterilize hands after washing with soap and has been used a number of times in isolated food production areas. It can be used for surfaces and utensils after they have been washed properly with soap and other detergents. Tables can be rinsed with this solution and left to dry by itself. High risk items such as knives and chopping boards can be soaked in this solution overnight. If finances permit there is a range of specialised cleaning material that allows equipment to be cleaned without dismantling every time (so called, clean-in-place; CIP.)
## APPENDIX 6

### Cost of Fittings for Processing

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tables (Stainless steel 2 modules)</td>
<td>$NZD 1,150 ea $NZD 2,300</td>
</tr>
<tr>
<td>Water Tanks (x3)</td>
<td>$FJD 2,375 (optional) $FJD 7,125</td>
</tr>
<tr>
<td>Filtration Cartridges (x4)</td>
<td>$FJD 1,500</td>
</tr>
<tr>
<td>UV Steriliser</td>
<td>$FJD 3,850</td>
</tr>
<tr>
<td>Water filter (5,000L per day)</td>
<td>$FJD 521</td>
</tr>
<tr>
<td>Insecto-cuters $FJD 1,200 ea</td>
<td>$FJD 3,600</td>
</tr>
<tr>
<td>Metal detector (Optional)</td>
<td>$FJD 40,00</td>
</tr>
<tr>
<td>Refurbishment and plumbing (Goulding Fiji) est</td>
<td>$FJD 30,000</td>
</tr>
<tr>
<td>Thermometers, timing devices (est)</td>
<td>$FJD 2,500</td>
</tr>
<tr>
<td>Scales 0 – 50Kg Tare 10Kg</td>
<td>$NZD 12,400</td>
</tr>
<tr>
<td>Safety gumboots $FJD 75.00 ea (x11 staff)</td>
<td>$FJD 825</td>
</tr>
<tr>
<td>Impulse bag sealers x 2</td>
<td>$FJD 240</td>
</tr>
<tr>
<td>Chest freezers (Courts Fiji Ltd) 2x</td>
<td>$FJD 2,839</td>
</tr>
<tr>
<td></td>
<td>$FJD 5,678</td>
</tr>
</tbody>
</table>
APPENDIX 7

References

Bell, JD., Johnson, JE and Hobday. (2014) Secretariat of the Pacific Community; Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change.


Naqasima, M, (1996), An Investigation of the Public Health and Fisheries Issues Concerning Anadara antiquata (Mollusca bivalvia; Arcidac) and Batissa violacea (Bivalvia; Corbiculacca), MSc Thesis, USP.


APPENDIX 8

Scope of Work

The consultant shall carry out the following tasks:

1. Establish the most appropriate location in which kai is collected and identify active fishers in that locale that are willing to undergo training for value adding.
2. Arrange equipment and training sessions with the Sai Yee Co Ltd to undertake training of 15 fishers at the Sai Yee location in Lami.
3. Establish working location where pilot scale processing can be undertaken.
4. Establish the chain and evaluate the weights and value addition for each step.
5. Establish the profile of E coli and Aerobic Plate Count along the chain.
6. Modify the value chain as required.
7. Establish acceptability at Sai Yee Co Ltd and reaffirm return for effort for fishers.
8. Establish sustainability for Sai Yee Co Ltd and other tourist outlets.
9. Prepare a case for the establishment of a permanent processing facility near the fishery
10. Prepare a report covering all aspects of the work.
APPENDIX 9
## Evaluation Form

**Product:** KAI

### Appearance

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent appearance</td>
<td></td>
</tr>
<tr>
<td>Very good appearance</td>
<td></td>
</tr>
<tr>
<td>Good appearance</td>
<td></td>
</tr>
<tr>
<td>Moderately good</td>
<td></td>
</tr>
<tr>
<td>Neither like nor dislike</td>
<td></td>
</tr>
<tr>
<td>Moderately poor</td>
<td></td>
</tr>
<tr>
<td>Poor appearance</td>
<td></td>
</tr>
<tr>
<td>Very poor appearance</td>
<td></td>
</tr>
<tr>
<td>Totally unacceptable</td>
<td></td>
</tr>
</tbody>
</table>

### Aroma

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent aroma</td>
<td></td>
</tr>
<tr>
<td>Very good aroma</td>
<td></td>
</tr>
<tr>
<td>Good aroma</td>
<td></td>
</tr>
<tr>
<td>Quite good aroma</td>
<td></td>
</tr>
<tr>
<td>Neither like nor dislike</td>
<td></td>
</tr>
<tr>
<td>Slightly unacceptable</td>
<td></td>
</tr>
<tr>
<td>Moderately unacceptable</td>
<td></td>
</tr>
<tr>
<td>Unacceptable</td>
<td></td>
</tr>
<tr>
<td>Very unacceptable</td>
<td></td>
</tr>
</tbody>
</table>

### Taste

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent taste</td>
<td></td>
</tr>
<tr>
<td>Very good taste</td>
<td></td>
</tr>
<tr>
<td>Good taste</td>
<td></td>
</tr>
<tr>
<td>Moderately good</td>
<td></td>
</tr>
<tr>
<td>Neither like nor dislike</td>
<td></td>
</tr>
<tr>
<td>Moderately poor taste</td>
<td></td>
</tr>
<tr>
<td>Poor taste</td>
<td></td>
</tr>
<tr>
<td>Very poor taste</td>
<td></td>
</tr>
<tr>
<td>Totally unacceptable</td>
<td></td>
</tr>
</tbody>
</table>

### Overall Acceptability

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent product</td>
<td></td>
</tr>
<tr>
<td>Very good product</td>
<td></td>
</tr>
<tr>
<td>Good product</td>
<td></td>
</tr>
<tr>
<td>Quite good product</td>
<td></td>
</tr>
<tr>
<td>Neither like nor dislike</td>
<td></td>
</tr>
<tr>
<td>Dislike slightly</td>
<td></td>
</tr>
<tr>
<td>Dislike moderately</td>
<td></td>
</tr>
<tr>
<td>Dislike</td>
<td></td>
</tr>
<tr>
<td>Totally unacceptable</td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

**Date:**

48