Determination of consumer preferences between commercial fish species

Australian Seafood CRC Australian Salmon Project

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Description:

This research is part of a larger project funded through the Australian Seafood CRC. Curtin University was asked to assist the project through conducting the sensory evaluation portion of the research

Aim:

The aim of this research is twofold:

i. To establish the eating quality preferences for fish of the average Australian consumer and their perceptions of Australian salmon eating quality.
ii. To determine how Australian salmon rates in the eyes of the average consumer when compared to six commercially available species.

Literature review

Increasing fish consumption in the wider population is desirable due to its potential contribution to a healthy diet and life style. However despite the desirability of promoting healthier eating, fish is still not consumed at levels suggested in healthy eating guidelines by most of the community (McManus et al. 2007; Leek, Maddock, and Foxall 2000). It is frequently assumed that people are consuming less fish because they don't like the 'fishy taste' or texture (Leek, Maddock, and Foxall 2000) yet it is also recognised that there are many different factors that can influence consumers' decision to purchase or to not purchase seafood.

Sensory aspects of the fish influence consumers' preferences in both the type of fish they buy and the amount they consume. Many quality measures cannot be determined until consumption, but appearance can be evaluated at the point of sale, be that at the fish shop or the restaurant (Hutchings 2002). The consumer uses the appearance of food to establish the species, variety, quality of the food, and its place in the customary eating pattern. Every food product has an acceptable appearance which is determined by the consumers' past experience and culturally accepted norms. If something about the appearance of a food product does not correspond with the memory of wholesomeness and hygiene the product will be unacceptable (Francis 1995). An unfortunate event associated with a particular product or situation will negatively influence our expectations when we meet that product or situation again (Hutchings 2003). If a product is believed to be acceptable but then undergoes negative changes after purchase, this will also impact on the likelihood of a repeated purchase by the consumer.

Appearance is an inclusive term that covers size, shape, texture, and colour. Of these factors colour is often the quickest and easiest quality characteristic for the consumer to evaluate (Hutchings 2002). Barbut (2004) found that the light used in displaying fish can influence the appearance of the fish. While most fish retailers use fluorescent lighting as it is cheap, this form of lighting is unable to show the red or pink in fillets to the best advantage, while it enhances the blue-grey aspects. Therefore, the colour of fish fillets could be distorted by the light used; convincing consumers the fish was not the best quality. It is preferable for coloured fillets to be placed under an incandescent light or a light source with red light output to improve the colour and appearance of the fish on display (Barbut 2004).

The texture of the fish is another property that can influence consumers in their choice of fish to purchase. Texture can influence how easy fish is to consume or if the mouth-feel is deemed to be unpleasant. The feel of fish in the mouth can be gritty, tender, or falling apart. It has been found that the production method can influence the texture of fish with farmed fish being less fatty, causing a firmer texture and thus being perceived as not as tender as wild caught fish of the same species (Kole et al. 2009). According to Spinks and Bose (2002), consumers also assess fish quality based on the odour. Thus the odour associated with the fish can either invite the consumers or put them off purchasing at the point of sale.

Flavour is thought to be the final decider in determining quality perception and has a large impact on whether or not consumers will return to buy fish and on the type of fish they choose. Lee and Maddock (2000) noted that it is frequently assumed that the flavour of fish is the strongest driver against purchase and consumption. This view was confirmed by Hicks, Pivarnik and McDermott (2008) who found 46 % of consumers surveyed choose not to eat fish as they do not like the flavour. Leek and Maddock (2000) also noted that meat products were perceived as offering a wider variety of flavours (beef, chicken, lamb) while all fish species were perceived to be very similar in taste. Yet Sawyer, Cardello and Prell (1988) found that the flavour of different fish species strongly influenced the consumer's preferences in the type of fish they purchased.

These sensory issues are complex and vary from consumer to consumer and interact with other factors to influence perception. There are also many barriers and beliefs that reduce the type and amount of fish people eat such as price, confidence in choice and preparation, reliability of the market, and influences of other household members (McManus et al. 2007; Fisheries Research and Development Corporation 2006).

The price of fish negatively influences the likelihood of consumption (Rahman and Driscoll 1991; Ruello and Associates Pty Ltd. 2006; Scholderer and Trondsen. 2008; Verbeke and Vackier 2005). Consumers believe fish is more expensive than other meat products (Hanson, Rauniyar, and Herrmann 1994) and are more likely to choose the cheaper option of red or white meat over fish.

Hicks, Pavarnik and McDermott (2008) found 45 % of consumers who do not eat fish do so to avoid the cost.

Many consumers choose not to eat fish or choose to only eat the fish they are familiar with as they have confidence in the labelling and marketing of fish (Hicks, Pivarnik, and McDermott. 2008; Ruello and Associates Pty Ltd. 2006; Verbeke and Vackier 2005). Sveinsdóttir et al. (2009) found adults under the age of 30 years consume significantly less fish as they are unsure of what they are buying. Furthermore, if a preferred species is unavailable, 35% of consumers in Sydney and 50% in Perth would choose another food altogether (Ruello and Associates Pty Ltd. 2002) rather than try a different species. Lack of confidence in the fish market underpins the belief that fish needs to be eaten on the day of purchase (Ruello and Associates Pty Ltd. 2006) instead of being able to be stored at home. This arises from the uncertainty as to the handling of the fish before it is sold. Consumers do not usually know if 'fresh' fish actually is fresh or if it has already been frozen and then thawed (Ruello and Associates Pty Ltd. 2006) which would influence how they can handle the fish themselves.

Consumers are also concerned about how wild fish are harvested and the potential impact on the environment, including dolphins and birds (Ruello and Associates Pty Ltd. 2006). In part this concern arises from the fact that consumers do not understand the regulations and practices of the industry (Ruello and Associates Pty Ltd. 2006). Therefore, because consumers do not know how fish have been previously handled and the effect on the quality of the fish and the environment, they are unsure as to what they are purchasing.

It is widely acknowledged that an increased intake of seafood is desirable with the Australian Dietary Guidelines advising that eating one or two fish meals per week is ideal for good health (NHMRC 2003). Unfortunately a higher consumption of some fish species may also lead to a increased risk of potentially harmful environmental contaminants such as methyl mercury, PCBs and dioxin (FSANZ 2010; Verbeke et al. 2008). Food Standards Australia and New Zealand (FSANZ) recommends that consumption of predator species such as shark and swordfish should be limited (FSANZ 2010). However, research has shown that consumers can become confused about how much fish should be consumed, how often and which species should be limited or avoided (Verbeke et al. 2008) resulting in them eating less fish overall.

Consumers also see fish as being difficult to prepare and serve compared to other types of meat (Leek, Maddock, and Foxall 2000). Many consumers admit to lacking confidence in fish preparation and cooking (McManus et al. 2007). New Zealanders have been found to be 59 times more likely to purchase fish that is easy to cook and handle (Spinks and Bose 2002). Once it is cooked, fish handling can still be difficult if the fish is full of bones. As fish bones can be very small, they are not necessarily easy to find and thus, can make fish difficult and unpleasant to eat (Ruello and Associates Pty Ltd.

2006; Verbeke and Vackier 2005). The bones in the fish can drive many consumers to eat other meats that are perceived as being less difficult (McManus et al. 2007; Leek, Maddock, and Foxall 2000).

A further influence on fish consumption is the pressure of others. Consumers are influenced more by the responsibility and social pressure to consume fish, than by the government health promotion messages, advertising and the food industry (Verbeke and Vackier 2005). Word of mouth or general disapproval of a fish product can have a significant impact on people's eating habits. Pressure can also come from inside the home. If one person in the family does not like fish, it makes it difficult for the rest of the household to consume it (Scholderer and Trondsen. 2008; McManus et al. 2007). Consequently, 16 % of people who do not consume fish on a regular basis, choose not to due to a family member's dislike of seafood (Hicks, Pivarnik, and McDermott. 2008).

While fish consumption occurs at all levels of society, there is an increase in fish consumption in higher demographic segments. Research has shown that increasing the level of education and income not only ensures that the consumer can afford fish, but also improves awareness of nutrition and health requirements (Hicks, Pivarnik, and McDermott. 2008). Furthermore, families with young children consume less fish (Verbeke and Vackier 2005) as funds are often tighter and children are fussier eaters. As a result, age and demographics can affect fish consumption such that in-home consumption rises with age as people become more aware of health and have more disposable income (Ruello and Associates Pty Ltd. 2006).

Not only is the species of fish important to influence consumption, but also the processing methods. Despite the shorter shelf life, New Zealanders are 32 times more likely to purchase fresh fish rather than frozen (Spinks and Bose 2002), whilst Australians show a significant preference for fresh fish with 77 % of consumers preferring fresh seafood, 41 % canned and 31 % frozen (Fisheries Research and Development Corporation 2006). On the other hand, consumption of value added fish products such as crumbed fish has risen (Scholderer and Trondsen. 2008) compared to fresh fish. This follows a trend across the whole food industry with an overall increase in consumption of value added products.

In conclusion, there are many different factors that affect fish purchasing decisions. These range from personal preferences for sensory characteristics to environmental and financial concerns. In understanding why a particular species of fish is or is not popular in the market place all these influencing factors need to be considered. The aim of this study is to gain some understanding of the factors that influence consumers when considering purchasing Australian salmon.

Methods

Five species of commercial fish were identified as having characteristics that span a range of fish eating quality. They are:

i. Snapper;
ii. Barramundi;
iii. Mullet;
iv. Spanish Mackerel; and
v. Whiting

These species were chosen in consultation with industry members based on their eating qualities (Table 1) and their cost.

Table 1: Species eating characteristics (Seafood Experience Australia nd)

	Snapper	*Barramundi*	*Mullet*	*Spanish Mackerel*	*Whiting*	*Australian salmon*
Flavour	Mild, Delicate and sweet	Mild	Strong Distinctive flavour.	Strong, Distinct, fishy flavour	Mild	Strong
Oiliness	Low	Low to medium	Low to high,	Medium to very High	Low	Low to Medium
Moisture	Moist	Moist	Moist	Dry to Medium	Moist	Dry to Medium
Texture	Medium Coarse flakes,	Medium to firm, Large flakes	Soft to medium	Medium to firm	Soft to Medium	Medium

These fish were used in all studies in conjunction with Australian salmon. Due to the timing of the trials it was not possible to buy the fish fresh so frozen fish fillets were purchased from local suppliers in Perth, Western Australia (WA) and stored at -22°C until required. All attempts were made to ensure the highest level of quality and safety whilst still ensuring that the fish purchased represented the local market. Australian salmon were purchased from fishermen in Albany on the day of harvest and couriered overnight on ice to a fish processor in Perth. The fish were skinned, filleted, trimmed of all dark flesh and vacuumed packed then blast frozen within 24 hours of capture. All fillets were then held at -22°C until required.

Initially it had been proposed that the fish would be grilled using a Silex clam shell grill however in establishing the cooking protocol it was noted that the Australian salmon did **not** grill well. It became very dry, relatively tasteless and unpleasant to eat. A review of the literature showed that when comparing multiple species it is desirable to use a cooking method that produced equivalent results in all fish species being assessed (Erkan and Özden 2007 ; Aubourg et al. 2005). A moist cooking method such as microwaving is recommended. The required numbers of fillets were

removed from the freezer 16 hours before they were needed and defrosted overnight at 4°C. The fillets were cut into equal size pieces and cooked 'on-demand' in a commercial microwave immediately prior to testing to limit variability in eating temperature and degree of cooking.

1. Consumer focus groups

Forty regular fish consumers in good health were recruited from the local population at Curtin University and from the surrounding community via email newsletters and posters displayed on Bentley campus (Appendix 1) and by word of mouth. A prize draw of gift vouchers for seafood from a well known supplier to the value of $150 was used to attract participants. Ethics approval for this research was obtained from the Curtin University Human Ethics Committee prior to commencement (Approval number: SPH-08-2010). All participants signed approved consent forms and underwent pre-screening to confirm their suitability for participation (Appendix 1).

Four groups of 10 people were formed and met for 1 hour in the focus group facilities at Curtin. Each participant completed a questionnaire on seafood consumption which was used to facilitate discussion (Appendix 2). The information obtained from the questionnaire was collated and the results expressed as percentages. The round-table discussion of fish eating quality characteristics and consumer drivers for and against consumption of fish was facilitated by an experienced group discussion leader. The guided discussion of fish flesh characteristics, costing and value aimed to determine:

i. What do consumers assess in terms of eating quality for fish species?
ii. How do consumers determine value (price points) when purchasing fish?
iii. Drivers for or against purchase of particular fish species

All comments were digitally recorded for later analysis.

The recorded discussions were transcribed immediately following each focus group and analysed thematically (McManus et al. 2007). The data was amalgamated and the major themes illustrated using participant quotes.

2. Consumer rating of sensory characteristics of Australian salmon

Based on the focus group discussion a sensory evaluation form was developed that covers the important determinants of eating quality. A labelled hedonic scale was utilised to collect the data (Appendix 3)(Lim, Wood, and Green 2009). The advantage of this scale is that it would yield ratio-level data on the magnitude of liking/disliking for the parameters of interest (Lim, Wood, and Green 2009). Consumers assessed appearance, odour, flavour texture and overall acceptability.

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Participants were asked to attend two sensory sessions spanning two days and assess the five species plus Australian salmon. In each test all panellists tasted Australian salmon plus 3 of the alternate species. Across the two days all panellists assessed all species. A randomised incomplete balanced block design was utilised for sample presentation to control for biasing factors such as presentation order and halo effects. Analysis of variance, repeated measures tests and preference mapping were used to analyse the data and determine how Australian salmon compared to other species in terms of acceptability and eating quality characteristics.

Results and discussion:

1. Consumer focus groups

A total of four focus groups were conducted (n=40 participants). Prior to the commencement of each focus group, participants completed a short quantitative survey. Results of the survey are summarised in table form as frequencies and percentages. Qualitative results from focus group discussions are illustrated throughout with quotes from participants in *italics.*

The dispersion of age and gender of focus group participants is shown in Table 2:

Table 2: Focus group characteristics: age & gender

Age group	*Total*	*Female*	*Male*
18-25 years	2	2	0
26-35 years	6	5	1
36-45 years	8	5	3
46-55 years	13	9	4
56+	11	9	2
Total	40	30	10

Investigation of household composition by age range represented by the participants showed that there was a broad spread of family size and generational distribution across the group (Table 3). 86.1% of participants had household members aged between 46 to 60 years who consumed fish (n= 31), while only 22% of participants' households had children under 12 who consumed fish.

Table 3: Household composition by age & fish consumption

Age group	*Household members who eat fish*	
Children under 12 years	8	22.2%
Teenagers 13-17 years	3	8.3%
Males 18-25 years	7	19.4%
Females 18-25 years	4	11.1%
Males 26-35 years	6	16.7%
Females 26-35 years	7	19.4%
Males 36-45 years	9	25.0%
Females 36-45 years	8	22.2%
Males 46-60 years	15	41.7%
Females 46-60 years	16	44.4%
Males over 60 years	7	19.4%
Females over 60 years	4	11.1%

Feedback from the focus groups clearly highlighted that the composition of the family has a strong influence of fish consumption. Many commented on the fact that younger children often disliked fish which influenced the family meal:

"What is limiting us is children, they have started refusing eating fish. That stops us from eating more fish. I have to cook sometimes two meals at night…if we are eating fish then my son refuses to eat fish then I have to cook another meal for him…. that is a big drawback"

"Our kids sort of determine sometimes the menu we have and how its cooked 'cause you go to an effort and they turn their noses up … you think 'what's the point?' so that's why we have a lot of crumbed stuff straight from the supermarket hopefully in time we will be able to encourage them to enjoy the finer taste of fresh fish rather than just the crumbed stuff from the supermarket"

"They would eat the fish and chips ….They see that as different …I think it is the chips…so that is what I have started doing…buy some chips if we have fish at home just to entice them to eating the fish"

For others the expense of a fish meal for a family was seen as a major disincentive to purchasing more fish, particularly in families with older children:

"We have three 20 year old pluses and sundry girlfriends and friends or whatever so to have a fish meal for everyone can be very expensive but for two of us it doesn't really matter… but when you are feeding a lot of mouths it does matter … it is competing with other products"

"For me…having four adults in the house meant…for fish…it was just impossible…I am looking forward to the time when I'm just with my husband and we can eat a lot more because we can afford it …for me it is a luxury item that I have had to make a choice about."

All participants were regular to frequent fish consumers with 44.4% of participants consuming fish more than once per week (Table 4).

Table 4: Frequency of consumption

Frequency of consumption	*Count*	*Percentage*
about once every 3 weeks	2	5.6%
about once per fortnight	7	19.4%
about once per week	11	30.6%
more than once per week	16	44.4%
Total	36	100.0

Participants were asked to indicate the types of fish products that they would regularly buy to cook at home. From Table 5 it can be clearly seen that the most frequent purchase was uncoated fresh chilled fish (44.3%) with uncoated frozen fish as second preference (22.9%). Value added products (crumbed, fish fingers etc) made up the other 32.6% of fish purchases. The one person who brought 'none of the above' products solely consumed canned fish.

Table 5: Types of fish products regularly bought

Product type	*Purchase rate*	
Uncoated fresh/chilled whole fish/fillets	31	44.3%
Uncoated Frozen Whole Fish or Fillets	16	22.9%
Frozen Fish Products (eg. fish cakes, fingers)	9	12.9%
Coated frozen fish fillets	7	10%
Coated Fresh/Chilled Whole Fish or Fillets	3	4.3%
Fresh/Chilled Fish Products (eg. fish cakes, fingers)	3	4.3%
None of the above	1	1.4%

Some feedback was given by the participants as to why they bought certain types of products:

"More often than not I would still buy frozen fish because I have brought fresh fish in the past and by the time I have got it home … I don't have a chance to smell it or do anything… and I've just tossed it in the bin so I tend to get frozen fillets"

"Crumbed fish and fresh fish because my wife will only eat fish …won't eat meat …and she likes the convenience of being able to come home and put the stuff in the oven and it ready in 10 minutes ..crumbed fish you can do that but fresh fish you have to do a bit more preparation so it is a bit more of an elaborate meal"

"I do buy crumbed fish …it is about convenience so if I haven't prepared anything and need a quick meal we could have that … while fresh fish would be cooked on the day"

As uncoated fish (either fresh or frozen) was the main product purchased it was not surprising that pan frying was the most commonly preferred cooking method by 77.8% of the participants (Table 6). Preferences for grilling, baking, BBQ and Asian cooking were all very similar at 44 to 47%. The least preferred method was poaching at 13.9% (Table 6).

Table 6: Preferred cooking methods

Cooking method	*Count*	*%*
Pan Fry	28	77.8
Grill	17	47.2
Asian cooking	16	44.4
Bake	16	44.4
BBQ	16	44.4
Green curry	13	36.1
As an ingredient in a dish (i.e. Pasta, rice, pie, soup)	12	33.3
Steam	11	30.6
I eat fish raw	9	25.0
Smoked	8	22.2
Poach	5	13.9

The cooking method was also equated to the fact that fish dishes were generally seen as 'fast food' when consumed as part of a normal diet:

"What night do I have the least time? so I can bung on a bit of fish and whack it on the table because it is about time for me …when I haven't got much time that would be the night that I would choose (to eat fish)."

"It is the time thing for me because it is so much quicker than a lot of other dishes and I feel quite happy with the way I cook my fish…I don't have a problem with it"

When asked about purchasing patterns participants fell into two groups: those who purchased fish at supermarkets (58.3%) and those who most frequently purchased fish from other sources (41.7%) (Table 7). Of the alternate sources a fishmonger was the most preferred place of purchase (30.6 %).

Table 7: Place most frequently purchased from

Place of purchase	*Purchase frequency*							*Most frequent place of purchase*
	Never	about once or twice a year	about once per month	about once every 3 weeks	about once per fortnight	about once per week	more than once per week	
Supermarket	4 11.1%	4 11.1%	3 8.3%	2 5.6%	8 22.2%	12 33.3%	3 8.3%	21 58.3%
Fishmonger	7 19.4%	13 36.1%	2 5.6%	4 11.1%	7 19.4%	3 8.3%	0 .0%	11 30.6%
Markets	16 44.4%	11 30.6%	4 11.1%	2 5.6%	3 8.3%	0 .0%	0 .0%	3 8.3%
Fish & chip shop	10 27.8%	14 38.9%	10 27.8%	1 2.8%	1 2.8%	0 .0%	0 .0%	1 2.8%
Restaurant	8 22.2%	11 30.6%	12 33.3%	1 2.8%	2 5.6%	2 5.6%	0 .0%	0 0%

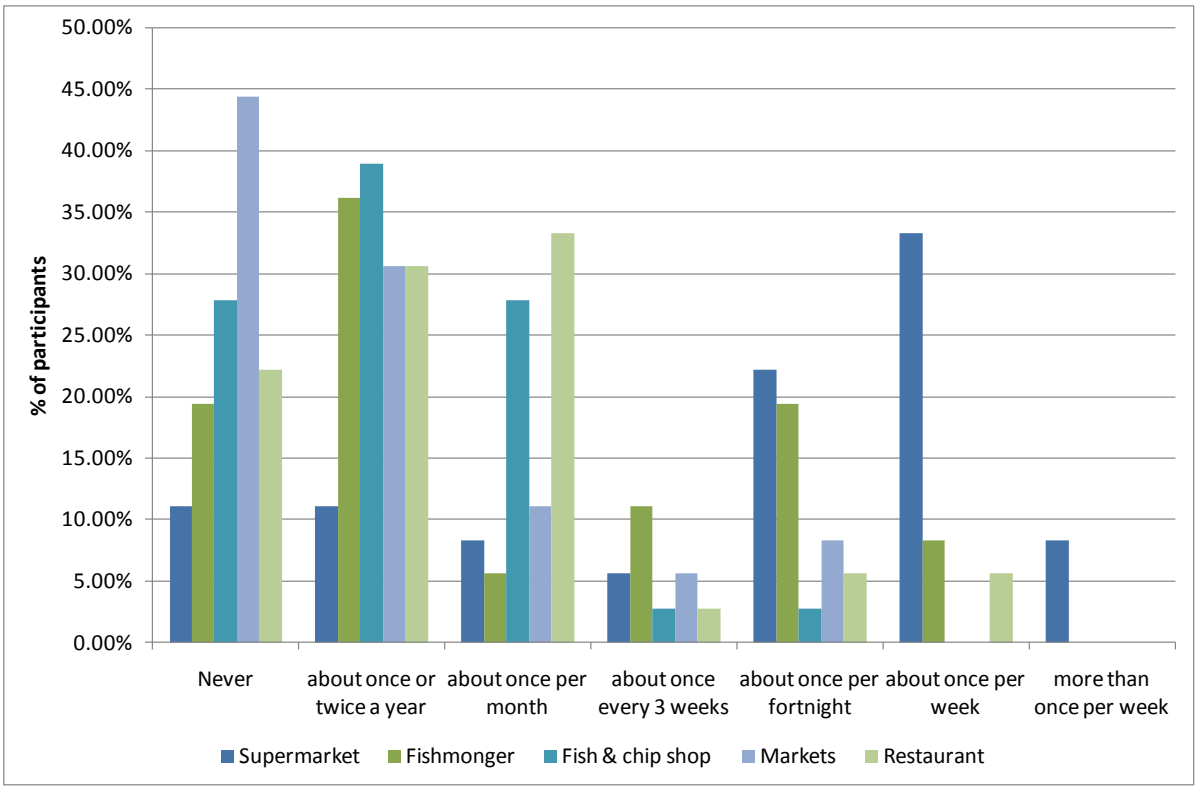


Figure 1: Place of purchase frequency

When frequency of purchase was investigated, 33% of participants purchased fish 'about once per week' from the supermarket compared to only 8.3% purchasing weekly from the fishmonger

(Table 7 and Figure 1). Consumers purchasing from the fishmonger tended to do so on a fortnightly to monthly basis (total = 36.1%) but it was also noted that many consumers (36.1%) purchased fish from a fish monger only once or twice a year. Purchases from a fish and chip shop, market or restaurant also tended to be less frequent (once per month or greater). Participants were least likely to purchase fish from markets than any other source (44.4% in 'never' purchase). Feedback from the participants on this varying purchasing pattern identified some interesting motivations.

For the supermarkets:

"I buy from a supermarket because it is very convenient and I don't like to travel that far"

"It's more convenient to go to the supermarket… you can have canned, frozen… like the variety"

I get it from the supermarket ... mostly because of convenience rather than having to buy something here , something there…If I can get it all in the one place as normally I have a little four year old that I drag around with me so it's for convenience

Against the supermarkets:

"I never buy fresh fish from a supermarket …I think because of the difficulty in trying to find out whether it has been frozen and defrosted, and where it is from … quite often when you do ask it's not quite clear that the people who are serving you know, where as when you go to a fish mongers they will straight out tell you where it is from …. And they are not confused by it whereas when you ask at the supermarket they say oh I don't know …I will have to go and check with someone else…."

"I hate it when you go to the supermarket and they've got them out there and they're semi-frozen and it is defreezing (sic) in front of you …I hate that!…and then they get the spray and wipe and they are spraying the glass on the inside…I would never buy fish from those particularly places…that's why I chose the frozen that is already packaged so that at least I have some degree of confidence ….I would go to the fish monger rather than buying at a supermarket which it is on ice…just lacking confidence in the product when it's like that"

"I think there is a perception too about the time between catch and sell… I used to feel a supermarket had gone through a number of levels before it gets there whereas you trust a fish monger to be fairly fresh or if its frozen to be snap freeze and I just don't feel … I don't have the confidence in supermarkets even with QA systems…I don't believe the freshness is there …having people who work in supermarkets who tell me 'don't buy from here!' because it has been here for X amount of time..."

For the fish monger:

"I don't trust that the supermarket to have fish as good as the fish monger…I am not willing to pay $60 for fish at a supermarket but I will at a fish monger… I am not prepared to pay the same price to a supermarket as a fish monger"

"Generally I buy fish from the fish monger or fish market as I believe generally its fresher and who wants to give money to the supermarkets"

"Frozen fish mostly from the market or frozen fish supplier ….I buy in bulk so that I don't have to go back every week … it's about convenience"

You need to have confidence in the people selling it to you to know what they are talking about …. In a specialist fish shop they should know what they are talking about"

For the Markets:

"We … every few weeks when we can be bothered getting up at 5 am… 5.30 go to the Markets and we will buy a bulk lot and put it in the deep freeze"

Against the Markets:

"Nearly always buy from the supermarket ….very occasionally from the Markets but I don't really like there…their grab it …grab everything type of marketing that goes on there…bit of a mad rush… don't really like that."

Overall the participants strongly agreed that having knowledgeable people selling the fish was a definite advantage and would influence their choice of place of purchase to some extent.

"I want to buy fish from someone who knows about fish…like when I go to the butcher I want a butcher who knows – where it came from, what it had been feed on…they can recommend something and they are never wrong… that is wonderful … they give you something and you take it home and it is just fantastic and you think 'mmm I will go back there!'"

When purchasing fish and determining value for money it was clear that a very varied set of motivating factors come in to play. The first thing people tended to do was assess the quality of the product based on appearance and odour (Hutchings 2002; Spinks and Bose 2002).

"Colour …it gets a grey look when it's a bit old."

"The fresh fillet has a sheen to it …they are a bit more shiny …I can't say exactly but when I look at a fish I can tell if it is rotten or not"

"Flesh has to glisten, scales intact, clear eye, not looking dried out or leathery"

"Bright eyes and gills are red… they are fresh "

"Whole fish…. you always look at the eyes…if they are clear and protruding not sunken and dry and if its filleted fish you look and see if it has got a lovely smooth silky look about it …without

picking it up and feeling it ..if it has been there a while it will look dry around the edges… any dryness… WALK."

"It is the smell… fresh fish shouldn't smell …should it? …that's why I don't buy 'fresh' fish from the supermarket because when I walk past a fish counter in the supermarket it stinks of fish …and that isn't fresh"

"If it is at the market and you can touch it not mushy flesh"

"Buy fish on what looks the best and then after that I weigh up the price"

Price was a major motivating factor but the comments clearly showed that its importance was modified by the other competing factors. The overall perception that fish was that it was a more expensive alternative to other protein sources.

"The problem with fish is that it costs that much more that you are terrified of screwing it up… you are more prepared to try out new things with cheaper cuts or types of meat"

"It is quite expensive compared to other meats so you don't eat it as much as you would like to …when you are getting up to the $40 per kilo for fish it can be a deciding factor… it is really competing for the space on the plate…if they were more equivalently priced I would consume more fish… unequivocally"

"If it was more competitive with meat prices I would buy more…"

As part of this discussion it was noted that the consumption occasion dictated the price that would be paid:

"I think sometimes you make decisions…you are going a BBQ or have people over and you are going cook a whole fish so you are going to buy a fish no matter what and I am not sure that price comes into it play there. If you are looking at it more as an everyday type meal or a source of protein then yeah I think price does come into it".

In addition when discussing the price of fish it was often related to the household budget

"I would make more of an issue of getting my children to eat it if it was reasonably priced but if you have paid $35 for it and they are going to turn their noses up at it….. You don't want to waste it "

"To have a fish meal for everyone can be very expensive but for two of us it doesn't really matter… but when you are feeding a lot of mouths it does matter … it is competing with other products"

Consumers also noted that they made comparative decisions in fish choice based on price

"Sometimes price will influence which fish we buy so for instance so if something is especially cheap, especially fresh when we go to the Markets…. if Goldband Snapper is at $16 per kilo and

some other snapper which is almost as good is only $3 per kilo then I will buy that and decide what to do with it when we get home"

"Salmon is very well priced compared to most of the wild caught fish"

The participants also agreed that health benefit was an influence to purchase fish but did not always negate the negative impact of price

"Health reasons are an influence – they say it's good for you so you try to do the right thing but it is not really number one…Everyone recognises nutritional value, everybody realises we should be eating it …all those things are way up there on most people's radar but reality bites"

"We are trying to consume less red meat, more white meat but then the price of fish is stopping you … it's trying to compete with chicken and how can it?"

"The health aspect is very important – I take omega fish oil tablets but if I could eat more fish I wouldn't need to… I would be happy eat more fish if the price was right"

"One of the things that drive the regularity of eating fish is health …it's that time of week again... the other one is trying to cut down on the red meat, beef and sheep meat particularly, for sustainability so we will have a bit of fish instead of…not that fish might be that sustainable either but there is a bit of a replacement but more from a health perspective"

It is interesting to note that the participants indentified negative health connotations most strongly with the environment in which fish was grown or caught which in general translated to a negative view of imported fish and seafood

"I would probably be a bit more hesitant about fish from the top end…tropical type fish because I have heard about the possibility of poisoning from fish….. just as a concept"

"You don't know in other countries if it is sustainably fished or if it is from a fish farm…I have seen Asian fish farms and they are not very good …full of poisons"

"I buy Basa until yesterday I went ….someone says that it is full of mercury … I use for spaghetti marinara and a whole range of things …but now…I think 'O God!' but it is so cheap!!"

"Imports are cheaper from China …but I am concerned about the contamination from those Asian countries"

Concerns about predator fish were also expressed in terms of health

"If it was something like sword fish then I wouldn't buy it even if it was cheaper 'cause it is higher up the food chain… Top order predators have all got methyl mercury so you have to be a bit careful - safety"

"Swordfish …I have heard swordfish carries lots of mercury as well and I won't eat it for health reasons…and I have also heard, though I don't know if it's true, but they are really prone to

parasites and part of preparing a swordfish is removing all the worms…I mean that got me thinking!!."

"I am a bit paranoid about mercury and I read somewhere that a tin of tuna has enough in it that it would exceed your weekly dose …so I have cut down on the tinned stuff"

"Sharks and swordfish are high in mercury…and sharks are also supposed to be endangered now…there has been a lot of publicity about that lately"

Social concern and concern about environmental impacts also contributed to reasons against consumption of certain fish species or fish from certain countries

"Most times when I buy fish I try and buy fish that is local fish not imported, like Nile perch for example and …because some of the fish that comes from …. that is imported ….you're not quite sure what the water is like where the fish have been swimming …is it high mercury, magnesium or whatever…what are the social circumstances of the people who were fishing … Like those tuna fishermen in south east Asia that have been on boats for three years and they are paid a pittance and yet it is the larger conglomerates that buy the fish off them…they are small boats and they unload their catch in mid ocean to larger boats which then take it on shore and the fish ends up in John West or wherever… and it just the ethics of it"

"I am concerned by the carbon footprint of the imported products so I tend to buy Australian …not always the most expensive fish of course …I would think about the ships carting tins…you know…tins of salmon or tuna from Alaska , …its madness"

"I try to choose the dolphin friendly ones"

"A thought came to mind about river fish, estuarine fish and ocean fish and that to me… I have a bit more of a negative perception about riverine and estuarine fish than ocean so that things like Barramundi …perhaps I shouldn't assume this… but I would tend to be less inclined to purchase them…the ocean is cleaner"

The concerns about harvest environment were also identified as a major driver that encouraged participants to 'Buy Australian'.

"Country of origin is very important …. dictates what I buy…if it is from Australia or New Zealand then I will buy it if it is from anywhere else then I won't buy it"

"It is about food miles, time and supporting your local industry"

"I would only buy Australian … that would mean I would go without rather than purchase something that has been imported"

However this driver was modified by the price differential and to some extent would dictate the type of fish participants would buy

"I like to buy a lot of Australian product…fish… and it is just so much more expensive otherwise… if it was not that expensive we would eat a lot more fish"

"If it's not much dearer I definitely buy Australian…But if there is a big price difference I would have look around for something that's a bit cheaper and Australian because you know you don't want to be buying the mercury … but it's not very often that you get a huge range of Australian fish to choose from"

"If we buy fresh fish it has to be Australian but that is not so easy because it is very expensive so we don't buy it as often as we used it

"I find that choices are very limited particularly if you are looking for the Australian one so I am really limited to what's there unless I went out of my way to buy something special at a fish monger or something like that …but like you can't always get cobbler…its getting really really hard to get now it used to be readily available …so I feel limited by what's available"

A continuing theme during this discussion was the need for information about:

1. Where the fish came from

"It would be good to know where it was caught …just like you can go to the place to buy fruit and vegetables they have on everything where it is from …is it from WA or even for fish you might want it to be smaller than that because I prefer to buy local fish"

"I think there might be room for something like Harvey beef….you know it comes from down south they have a little description of it ..dates and all that …I wouldn't mind having 'X fish' with its origin and when it was caught or frozen or whatever and a bit more about it …it is really an article of faith when you buy that fish in plastic…"

"There is a family owned business they actually have on there a map with a mark where it's actually from…I think it is reassuring when you see that ...it actually identifies it …you'd hope that its right"

2. How the fish was grown and or harvested:

"There is very little information out there about fish …we don't even know …it would be nice to know a bit more information about the fish itself…where its caught from …its origin"

"The image of 'clean green' is important …I would like to know more about the fish that we have in the market ….but really most of the people selling the fish have no idea themselves. "

"That is the barramundi problem ….if it is going to be that inconsistent you will stop buying barramundi in WA …if you knew it was North Coast of Western Australia you would buy it but if you think it was coming from further away and its poorer quality it does stop you buying it."

3. The cooking and eating characteristics of the fish

"If you buy fish from a fish monger and you ask him "how do you prepare that?" he will go for 10 minutes explaining every detail …its part of the service …and the next time you try something else …I think that knowing how to prepare the fish is half the problem solved."

"It's really helpful to know what a fish is good for …steam, baked, pan fired –that's handy"

"….don't give me the recipes …give me general guides on how to cook it as in …a firm white fish… good poached, steamed …."

"If I had a bit more of an idea of what the characteristics of the fish are and how they would perform when cooked would help a lot so like 'is it a good texture and will hold together if cooked for longer time' …those sorts of things would really help because quite often you go back to the thing that you know when there might be something cheaper that would perform just as well"

"Not knowing how to cook a fish can put you off trying it ...not knowing how to approach it …it's a familiarity sort of thing …until you can 'break the ice' and then you find out this does taste pretty good!!…"

Clarity in naming fish species continued to be a problem for participants as they had no knowledge of the standardised fish names initiative

"I don't know what goldband snapper is but when you go in there is northwest snapper ….and a whole range so that you have no idea really … if you knew what it meant it might have some benefit"

"The thing about all these different species I think I would be confused about whether they are just made up names or whether they are really different …"

"It would be good to have a photo of the fish because it is very misleading …sometimes things like leather jacket is sometimes called silver flounder or something like that"

"One thing I will never buy in a restaurant is Barramundi because I am never sure that it is …I think there is that element as well sometimes you can pay some big money and you are really not sure that you are getting what you paid for and barramundi is one for me…"

Participants also noted that they were hesitant to try unfamiliar species for a variety of reasons

"It might taste horrible …it is a bit of a risk …you don't know whether you are going to waste your time and money."

"If I want to experiment I will do it at a restaurant…that's when well it has obviously been cooked well and I can get the taste at its best…"

"You do what you know at home unless you have time to experiment "

"…I stick to what is proven …you can't have a dud it is too expensive"

"I have my favourites and I would always go for the …salmon, mackerel…something good and oily …worth having a healthy meal

One point of contention around information provided at the point of purchase was the issue of 'fresh' versus 'freshly thawed' versus 'freshly frozen'

"And some of it's already been thawed by the time you get to it so it looks like fresh fish but it isn't it has been frozen and thawed 'for your convenience'… Some of the more honest places will have a little sign … but not all of them… It's only convenient if you are going to cook it that night…I would prefer to buy it frozen and then take it home and thaw it myself"

"But there is no guarantee of how it is frozen… it might be frozen immediately or a week after it is caught…how fresh is fresh?"

"If they are calling it fresh I would assume it has never been frozen "

The eating quality factors most likely to limit consumption were clearly related to bones and the sensory characteristics of the cooked fish. Of the sensory characteristics flavour and odour were the most frequently mentioned.

"The smell…he says he would eat it if it doesn't taste…smell like fish …I think the bones is another thing …we have to clean it for my daughter "

"I don't buy fresh water fish…I don't like the flavour"

"The big fishes don't have much bones in the tail bit of it…my husband just cuts the tail bit for children and then we don't mind the bones but it is good for the children …makes it so much easier"

"Mullet - I don't like the look of them and ….the really dark flesh but that's …I do like the oily fishes I still like salmon …I suppose it's just….more of the flavour?"

"I tend to ask the fish monger…if there is one…and choose the ones that are not really really strong fishy flavours. So if there is a choice I would ask them as to what they would recommend in terms of the milder flavoured fish"

Close investigation of consumers' awareness and purchase behaviour in relation to species of fish brought some interesting observations to light. Figure 2 summarises the results from the following questions

- Q5. Which of the following types of fish are you aware of?
- Q6. Which of the following types of fish have you ever bought?
- Q7. Which of the following types of fish do you regularly buy?
- Q8. Which of the following types of fish would you never consider purchasing?

Figure 2 shows that most species had 60% or higher recognition in response to question 5. However 50% or less of the participants were familiar with Goldband snapper and Hoki. However, awareness of a fish species did not necessarily translate into purchase behaviours as most species scored below 50% for question 6. Only 5 species (Atlantic salmon, barramundi, snapper, red emperor and whiting) achieved greater than 80% in response to question 6.

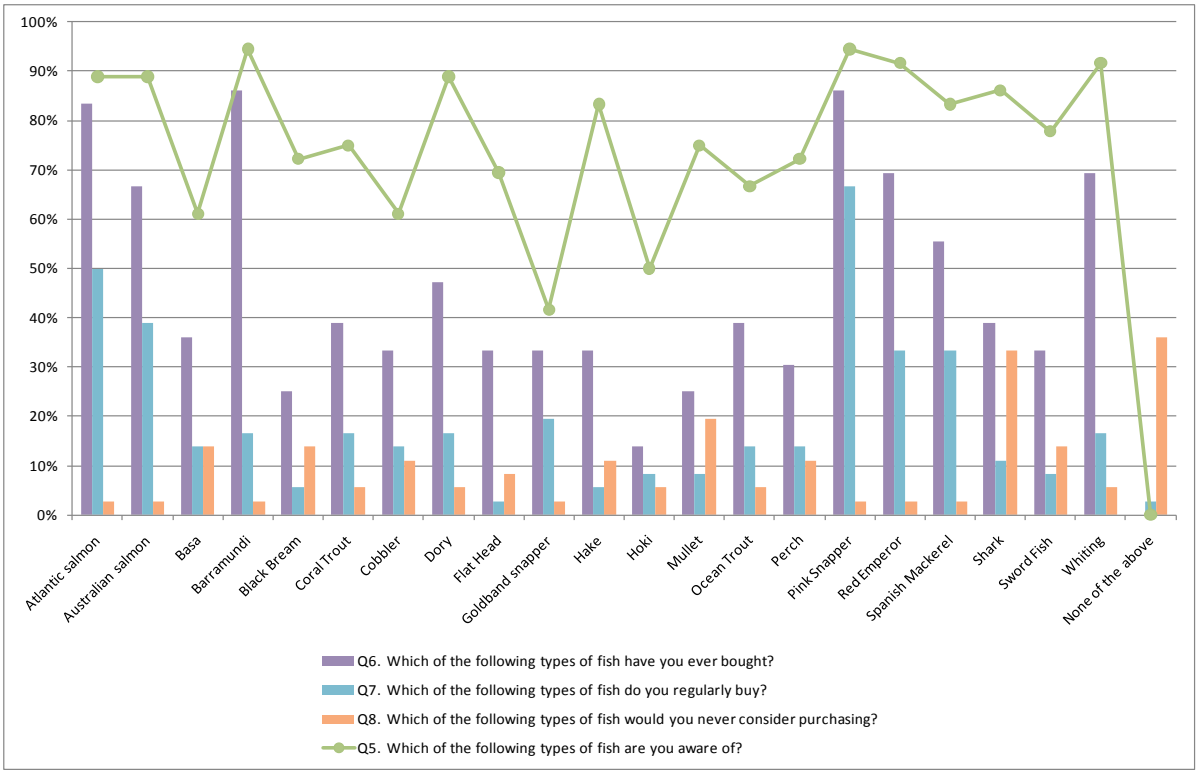


Figure 2: Awareness and purchasing behaviour related to fish species

While it would appear that Australian salmon also achieved high levels of recognition and purchase (66.7%, Table 8) this was not in fact the case. When questioned it was clear that the majority of participants had confused the species name with Atlantic salmon marketed as an Australian product. Only six people out of the 40 panellists were familiar with Australian salmon as a species and they were mostly people who regularly fished (approximately 16%, n=6). All others thought the fish being discussed was Atlantic salmon.

Australian salmon equals Tasmanian salmon … Atlantic salmon from Australia?

… I didn't know that it's not the same fish….I have started buying New Zealand salmon?

Table 8 showed that fish most regularly purchased were Atlantic salmon (50+38.9 = 88.9%) and snapper (66.7%). Black Bream, Flathead, and Hake (all less than 6%) were purchased with the lowest regularity. Shark lead the 'would never buy' field with 36.4% of participants indicating that they would never consider buying it followed by mullet (21.2%) then basa, black bream and sword fish at 15.2% each.

Table 8: Awareness and purchase behaviour by species

	Q5. Which of the following types of fish are you aware of?		*Q6. Which of the following types of fish have you ever bought?*		*Q7. Which of the following types of fish do you regularly buy?*		*Q8. Which of the following types of fish would you never consider purchasing?*	
Atlantic salmon	32	91.4%	30	83.3%	18	50.0%	1	3.0%
Australian salmon	32	91.4%	24	66.7%	14	38.9%	1	3.0%
Basa	22	62.9%	13	36.1%	5	13.9%	5	15.2%
Barramundi	34	97.1%	31	86.1%	6	16.7%	1	3.0%
Black Bream	26	74.3%	9	25.0%	2	5.6%	5	15.2%
Coral Trout	27	77.1%	14	38.9%	6	16.7%	2	6.1%
Cobbler	22	62.9%	12	33.3%	5	13.9%	4	12.1%
Dory	32	91.4%	17	47.2%	6	16.7%	2	6.1%
Flat Head	25	71.4%	12	33.3%	1	2.8%	3	9.1%
Goldband snapper	15	42.9%	12	33.3%	7	19.4%	1	3.0%
Hake	30	85.7%	12	33.3%	2	5.6%	4	12.1%
Hoki	18	51.4%	5	13.9%	3	8.3%	2	6.1%
Mullet	27	77.1%	9	25.0%	3	8.3%	7	21.2%
Ocean Trout	24	68.6%	14	38.9%	5	13.9%	2	6.1%
Perch	26	74.3%	11	30.6%	5	13.9%	4	12.1%
Red Emperor	33	94.3%	25	69.4%	12	33.3%	1	3.0%
Snapper	34	97.1%	31	86.1%	24	66.7%	1	3.0%
Spanish Mackerel	30	85.7%	20	55.6%	12	33.3%	1	3.0%
Shark	31	88.6%	14	38.9%	4	11.1%	12	36.4%
Sword Fish	28	80.0%	12	33.3%	3	8.3%	5	15.2%
Whiting	33	94.3%	25	69.4%	6	16.7%	2	6.1%
None of the above	0	.0%	0	.0%	1	2.8%	13	39.4%

Barriers against fish consumption were related to the participants' perceptions of the different species:

"I have never eaten shark…I don't know… may be out of curiosity…but I don't feel comfortable with buying it ….I don't like eating shark …it's just like you won't feel like eating koala meat or something…"

"Shark - because sharks eat people"

"Black bream has lots of small bones and is a bit of a problem for children"

"I don't know that I have ever tasted mullet…I think I have always thought of it as a very mushy oily fishy fish …and a strong flavour. I'm not really keen on a strong flavoured fish…My father, when we were growing up used to go out fishing in western Queensland, and he would catch Dhu fish and yellow belly and all that… we used to eat a lot when we were younger but mullet in my mind is …I wouldn't buy it I don't think. "

"Perch…it just doesn't appeal"

"Same thing with herring which is a really strong tasting fish but I won't buy it I will only eat what I caught because I don't think the fishermen or the fishery treat it with enough reverence… they should gut it straight away and take the scales off and I would buy the whole fish if they did it that way but it usually still got the scales on and the guts in but by then the guts have sort of leeched out and it is awful "

When asked about consumption of Australian salmon most consumers had never eaten it. Those who were aware of it were divided on its eating quality. Those who were negative said:

They are not particularly good eating …

My perception is that perhaps it's not premium…that's just a feeling I have got from nowhere in particular

While those who had positive experience said

We had it recently and it was really good …I was surprised.

It is very good in a curry … something where you want something with good body.

During the discussion it was clear that the name had built expectations that the fish could not deliver

A friend who has lived in Australia since he was 18 actually got caught out recently… in Broome …he ordered threadfin salmon and it came and it was white. ..he called the waiter over, got the chef out …"this isn't salmon" and he said "No it is Australian salmon"…he was quite disappointed

However many participants were prepared to try the product should it be available in the market'

I would give it a go … if it was local, fresh and reasonably priced

I would buy it a restaurant but I would not buy it to cook myself

From the discussion it is clear that drivers for and against fish consumption resulted in a complex decision making processes for consumers when considering fish purchase. It was obvious that price, household composition, sensory characteristics (odour, flavour, texture and appearance) and environmental concerns all contributed to the final purchase decision. It was also clear that Australian salmon was a relatively unknown species to the participants. This should be further investigated with larger groups of consumers to assess if there is an opportunity to expand its consumption in the Australian market.

2. Consumer rating of sensory characteristics of Australian salmon

Analysis of difference by sensory characteristic preference

The output of the focus groups showed that the sensory attributes of appearance, odour, flavour and texture were most important to fish consumers so these were evaluated in the sensory session over two days, with repeated measures between sets. The aim of repeated measures was to ensure there was no significant difference between the panel results from one day to the next (reliability) Statistical analysis of the sensory evaluation data showed that there was no significant difference ($p>0.05$) in the repeated measures of samples on different days by the same panellists so the data set can be treated as a complete unit.

When the mean values for each sensory characteristics of each species were compared it was clear that there were significant differences between species ($p<0.01$). Figure 3 shows the pattern of differences between species by sensory characteristic preference while Figure 4 shows the pattern of difference in sensory characteristics preference by species.

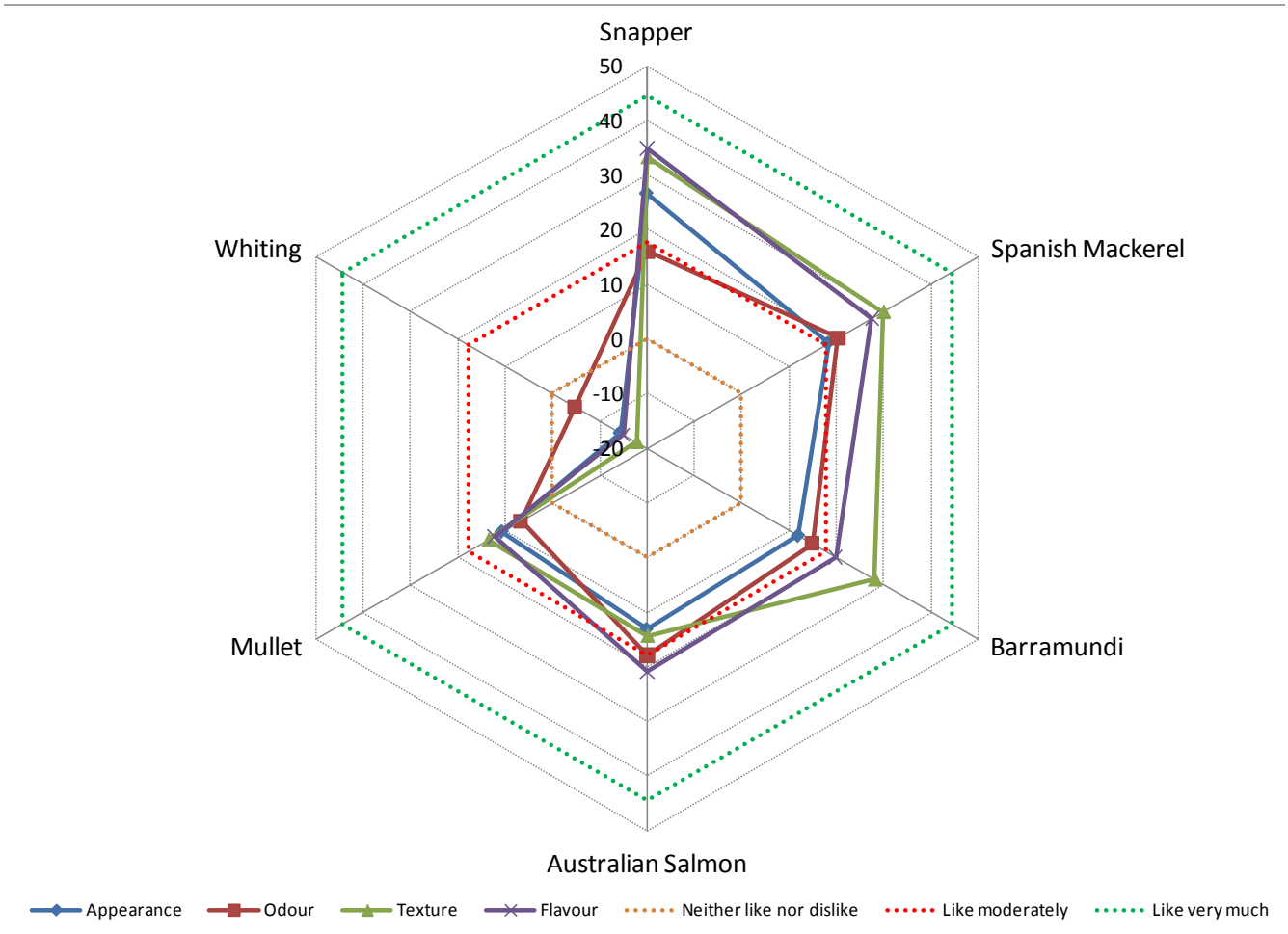


Figure 3: Differences between species by sensory characteristic preference for cooked fish

From Figure 3 it can be seen that none of the samples had average scores greater than 'like very much' (44.4). This is most likely due to the fact that the fish was cooked in the microwave and served without seasoning. The cooking and serving method was standardised to ensure that no biasing or confounding factors were introduced however it is recognised that the preference of consumers for fish prepared in this manner may be lower than usual preparation and consumption occasions.

Snapper and Spanish mackerel scored greater than or equal to 'like moderately' for all sensory characteristics. Australian salmon and barramundi scored just above or just below 'like moderately' for all parameters whilst mullet scored between the neutral point and 'like slightly 'across all parameters. Whiting was universally disliked for all parameters when cooked using a microwave (Figure 3). For all species there was significant correlation between the sensory characteristics evaluated and overall acceptability (Table 9).

Table 9: Correlation of acceptability to sensory character by species

	Appearance		*Flavour*		*Odour*		*Texture*	
Overall acceptability	Pearson Corr.	Sig. (2-tailed)	Pearson Corr.	Sig. (2-tailed)	Pearson Corr.	Sig. (2-tailed)	Pearson Corr.	Sig. (2-tailed)
Australian salmon	.402**	.007	.888**	.000	.366*	.015	.785**	.000
Barramundi	.591**	.000	.794**	.000	.286	.063	.858**	.000
Mullet	.576**	.000	.882**	.000	.786**	.000	.811**	.000
Snapper	.700**	.000	.879**	.000	.583**	.000	.795**	.000
Spanish Mackerel	.656**	.000	.933**	.000	.728**	.000	.833**	.000
Whiting	.394**	.008	.800**	.000	.455**	.002	.806**	.000

N.B. * = $p<0.05$, **=$p<0.01$

Examination of the individual species showed that snapper was the most preferred species for appearance, flavour and texture whilst Australian salmon and Spanish mackerel were most preferred for odour. Australian salmon scored higher or equal to barramundi for all parameters except texture (Figure 4).

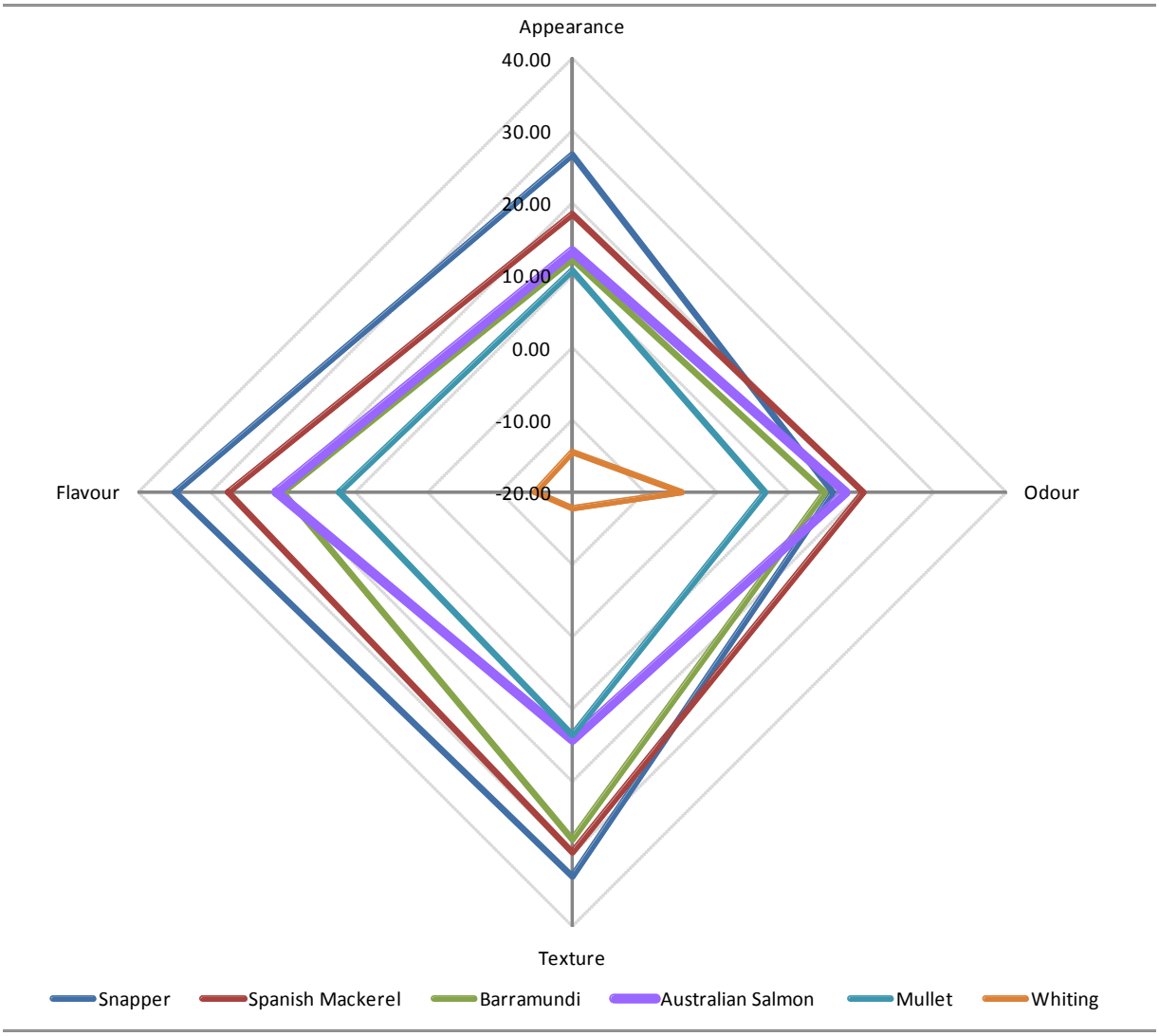


Figure 4: Difference in sensory characteristic preference by species for cooked fish

Comparison of the Australian salmon sensory preference profile (Figure 4) with that of other species shows that the preference for the odour of cooked Australian salmon fell between that of Spanish mackerel and snapper. Its texture was liked as much as mullet whilst preference for Australian salmon flavour and appearance was similar to that of Barramundi.

When the data were presented as a series of bar graphs the order of preference was clearly seen (Figure 5). Australian salmon consistently fell in the middle or higher of the six species tested.

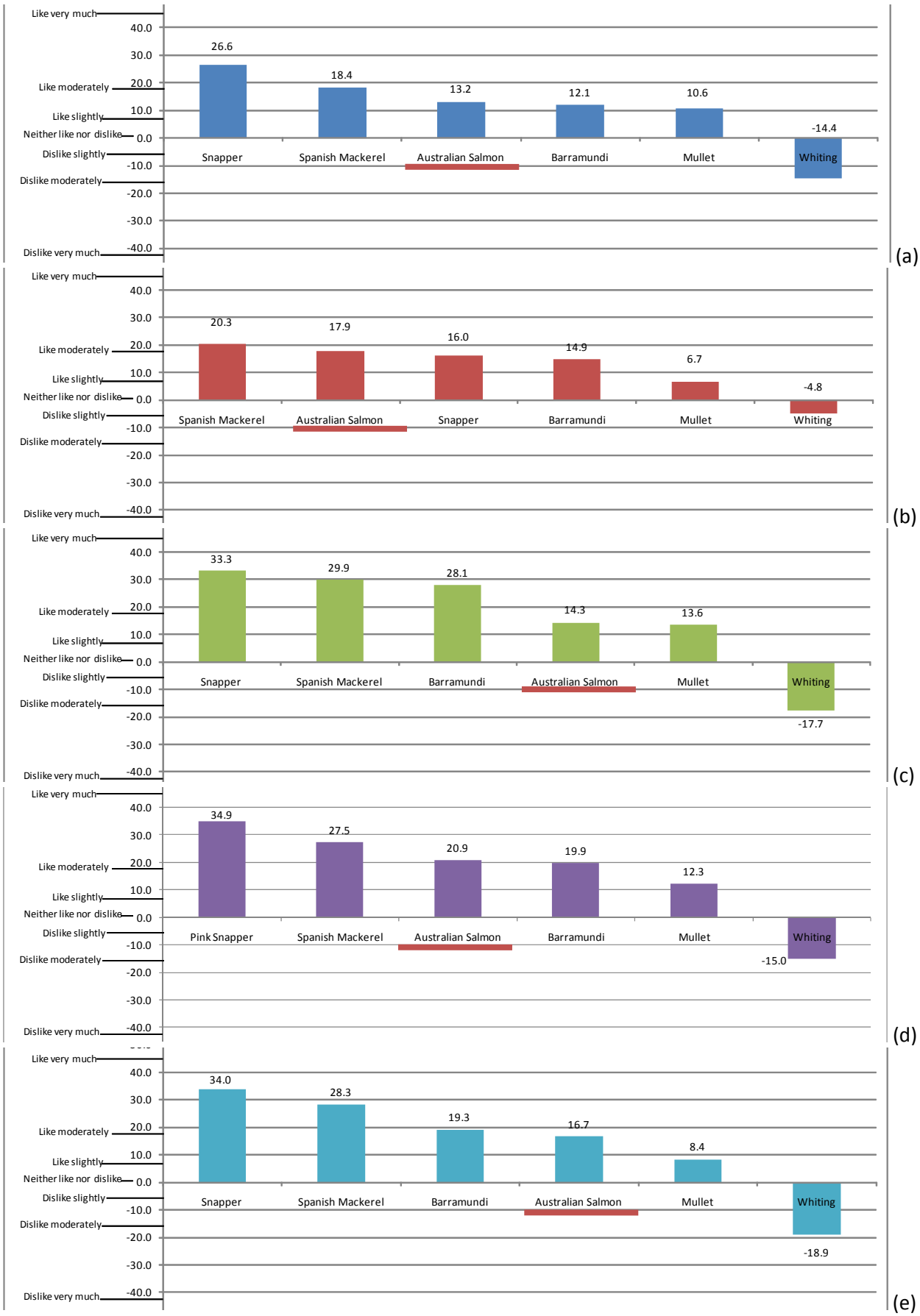
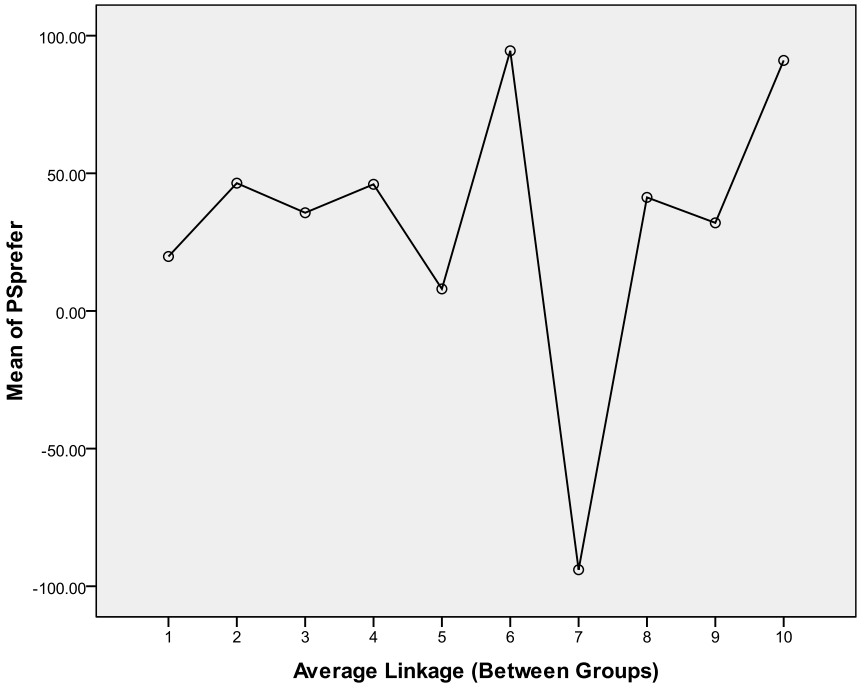


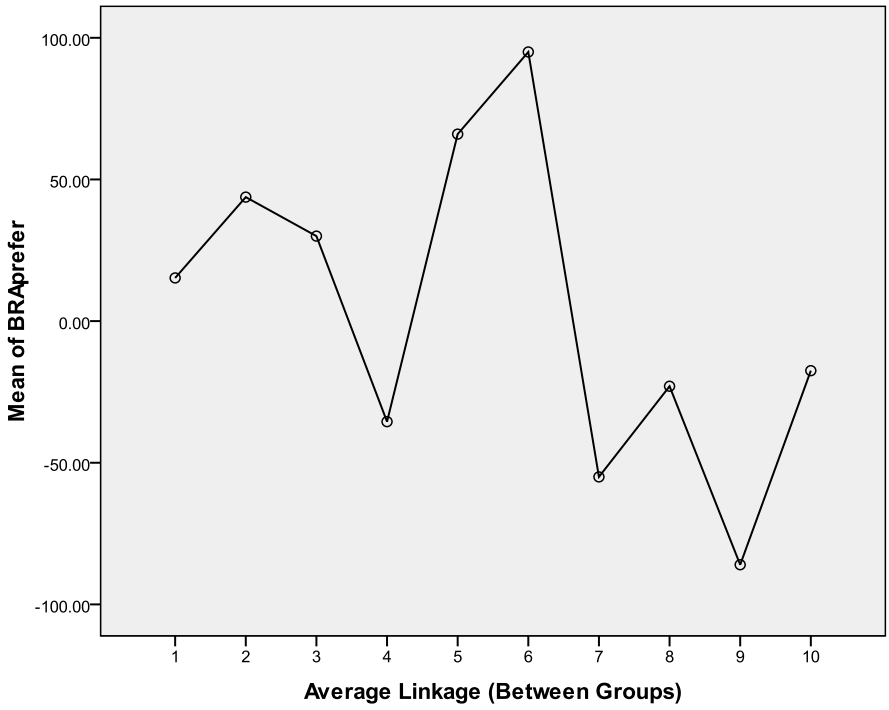
Figure 5: Preference for (a) appearance (b) odour, (c) texture (d) flavor and (e) overall preference of cooked fish

Cluster analysis by preference

By using principal component analysis and cluster analysis it is possible to analyse consumer preference for each species (Figure 6 a to f). Cluster segmentation established there were ten segments of preference however segments 4 to 10 had only one member each. Each member of these clusters had strong preferences or dislikes for one or more species of fish (figure 6 a to f). Therefore these seven segments were discarded and the remaining 3 segments were examined

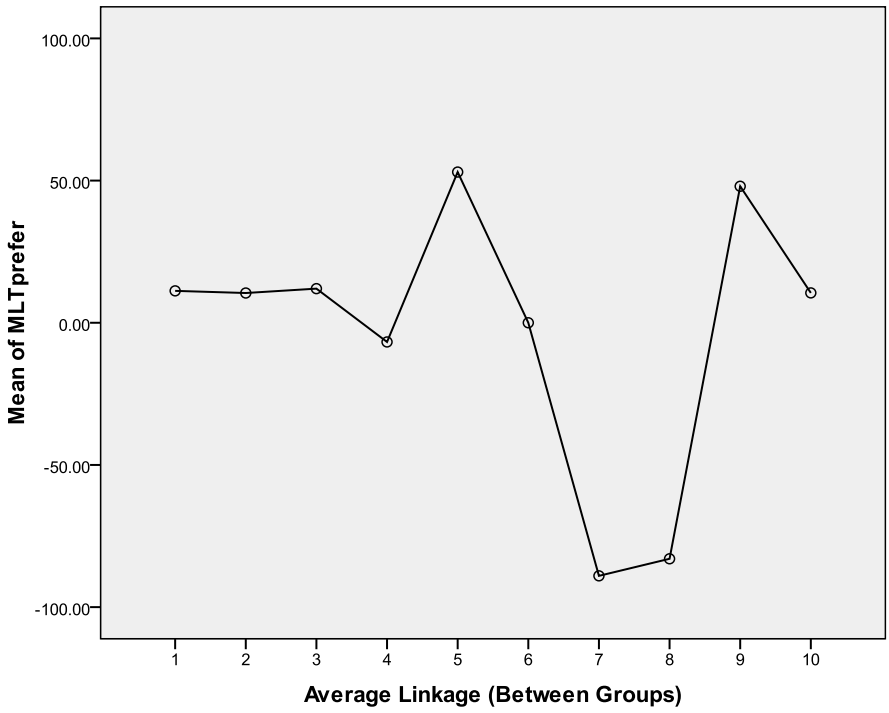


a) Snapper

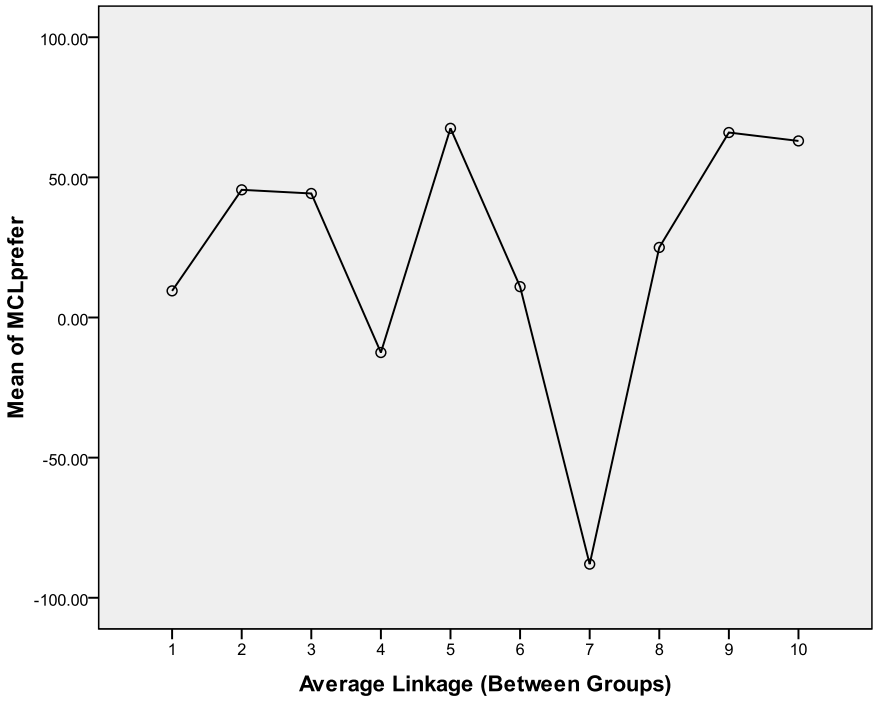


b) Barramundi

Figure 6 a-b: Clusters by preference for species (a) snapper, (b) barramundi

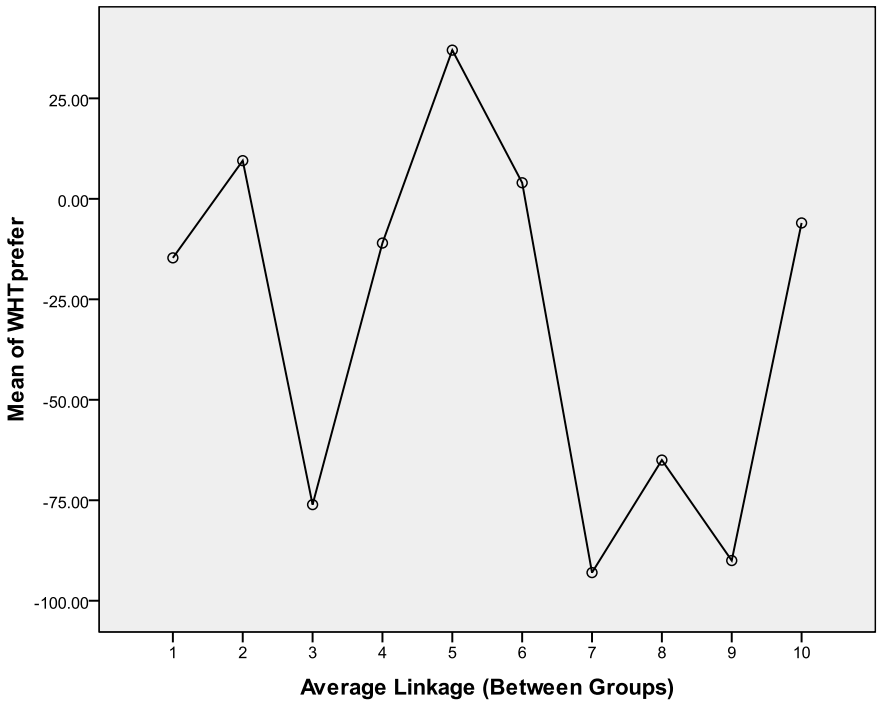


c) Mullet

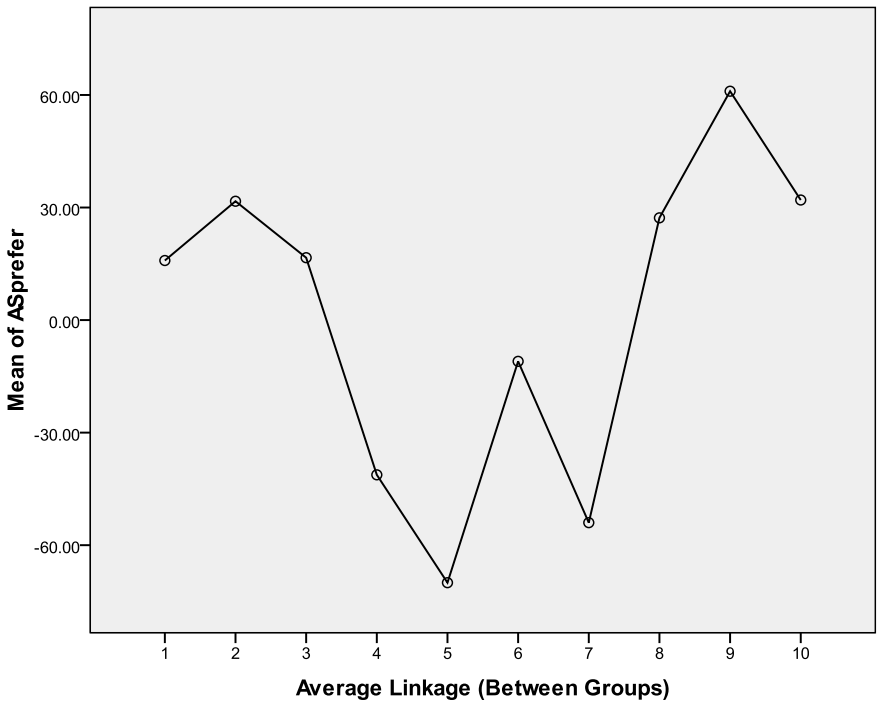


d) Spanish Mackerel

Figure 6 c-d: Clusters by preference for species (c) mullet, (d) Spanish mackerel



e) Whiting



f) Australian salmon

Figure 6 e-f: Clusters by preference for species (e) whiting, (f) Australian salmon

Overall Figure 6 shows that there were a few significant differences between groups:

- Cluster 1 (n=16): The members of this cluster disliked whiting yet did not have any strong preferences for any of the other species.

- Cluster 2 (n=13): This cluster had very strong preferences for snapper, barramundi and Spanish mackerel, but also liked Australian salmon. They found mullet and whiting just acceptable.
- Cluster 3 (n= 6): These participants have an overall strong preference for Spanish mackerel followed by barramundi and snapper. They strongly disliked whiting.

Investigation of preferences for different species showed that a liking for Australian salmon had as significant correlation to a liking for Spanish mackerel ($p<0.01$) and to a lesser extent snapper ($p<0.05$) (Table 10). Similarly, a liking for barramundi correlated to a liking for whiting ($p=0.01$) and snapper ($p<0.01$), while Spanish mackerel was also correlated with snapper ($p=0.001$) and mullet ($p=0.001$) (Table 10).

Table 10: Correlation of overall acceptability scores

Overall acceptability		*Mullet*	*Snapper*	*Spanish Mackerel*	*Whiting*
Australian salmon	Pearson Corr.	.387*		.450**	
	Sig. (2-tailed)	.010		.002	
Barramundi	Pearson Corr.	.434**			.391**
	Sig. (2-tailed)	.004			.010
Spanish Mackerel	Pearson Corr.	.490**	.513**		
	Sig. (2-tailed)	.001	.001		

Determining the sensory characteristics that predicted these correlations can be done by investigation of the correlations between liking for the sensory attributes of each species (Table 11). Australian salmon liking was correlated to Spanish mackerel and snapper based on appearance, flavour and odour ($p<0.01$ for all sensory characteristics). Barramundi liking was correlated with snapper with flavour and odour significantly correlated between species ($p<0.01$) and appearance and texture more weakly correlated ($p<0.05$). Barramundi liking was also correlated with whiting liking but solely on the basis of texture ($p<0.05$). Spanish mackerel liking was strongly related to mullet based on flavour odour and texture ($p\leq 0.01$) while appearance had no significance. Liking for Spanish mackerel was also strongly correlated to snapper liking based on appearance, odour and texture ($p<0.01$), and to a lesser extent flavour ($p<0.05$) (Table 11).

Table 11: Correlation of sensory attributes for selected species

			Mullet				*Snapper*				*Spanish Mackerel*				*Whiting*			
			A	*F*	*O*	*T*	*A*	*F*	*O*	*T*	*A*	*F*	*O*	*T*	*A*	*F*	*O*	*T*
Australian salmon	A	Pearson's					.588**				.501**							
		Sig.					.000				.001							
	F	Pearson's						.392**				.507**						
		Sig.						.008				.000						
	O	Pearson's							.452**				.501**					
		Sig.							.002				.001					
	T	Pearson's								.136				.273				
		Sig.								.385				.073				
Barramundi	A	Pearson's					.373*								.081			
		Sig.					.013								.601			
	F	Pearson's						.531**								.226		
		Sig.						.000								.140		
	O	Pearson's							.564**								-.066	
		Sig.							.000								.670	
	T	Pearson's								.322*								.306*
		Sig.								.035								.043
Spanish Mackerel	A	Pearson's	.157				.546**											
		Sig.	.316				.000											
	F	Pearson's		.476**				.377*										
		Sig.		.001				.012										
	O	Pearson's			.516**				.462**									
		Sig.			.000				.002									
	T	Pearson's				.496**				.574**								
		Sig.				.001				.000								

On the basis of the information gleaned from Table 10 and Table 11 and referring to the eating qualities described in Table 1, it is possible to draw the following conclusions about the possible fish consumption choices of the three consumer clusters identified in this study:

- Cluster 1 (n=16): these participants will eat any fish but found the texture of whiting used in this study too soft when cooked in a microwave,
- Cluster 2 (n=13): this group will seek out fish with medium to firm texture but do not like fish that is too strongly flavoured or soft.
- Cluster 3 (n= 6): this group favours fish that have a moist or oily texture with medium to firmer flesh. They do not like fish that is moist and soft.

It is interesting to note that from the results found here texture plays an important role in determine fish eating quality and influencing consumer liking. When handled correctly and prepared in a suitable fashion Australian salmon is as acceptable as, or more acceptable than, other species currently available on the market.

Conclusions

Purchase and consumption choices of consumers are based on the interplay of a complex set of factors. From this study it has been found that:

- Household composition interacted with income and price to determine the amount, frequency and type of fish that would be purchased and consumed
- The drive to 'buy Australian' was a factor in purchase decisions but was usually driven by environmental and health concerns about the quality of the growing environment, harvest and handling practises used in production of imported fish.
- Fresh fish was the most preferred option with frozen and value added products also being brought in most households. However when the consumer said fresh they meant NEVER frozen not freshly thawed.
- The major drivers that determined where consumers purchased fish were cost, convenience and availability. Consumers would go out of their way to buy fish from a fish monger for a special occasion but would often buy fish at supermarkets as a convenient purchase for regular meals.
- The consumer values knowledge and seeks more information about the fish they are purchasing – What is it? Where did it come from? And how is best prepared?
- Decisions about quality at point of purchase were very much based on appearance and odour.

- Knowledge and familiarity with species influenced purchase decisions with many consumers being unwilling to try out new species of fish due to the lack of knowledge and confidence in its preparation. This was tied into cost as they were unwilling to risk wasting expensive food.
- Very few consumers were familiar with Australian salmon and in discussion confused it with Atlantic salmon farmed in Australia. Those consumers who had experience of the fish had a very mixed perception on it based on past experience or hearsay.

Closer investigation of the reality of Australian salmon eating quality using consumer sensory evaluation clearly showed that when processed as rapidly as possible after capture and prepared in an appropriate manner the flesh of the fish was consistently more preferred than mullet and whiting for all sensory parameters and overall acceptance.

The outcomes of this study show that there is potential for development of a market for the Australian salmon catch in the fresh fish arena. However some factors will need further investigation. These include:

- The feasibility of developing suitable transportation and processing practises to ensure that the fish is processed as rapidly as possible after capture. All fillets would need to be trimmed of as much dark flesh as possible, vacuum packed immediately to maintain colour and prevent browning, then frozen as quickly as possible.
- The possible use of Australian salmon in value added products such as fish cakes, soups etc
- Changing the name of the fish to remove the confusion with Australian-produced Atlantic salmon
- Marketing campaigns to promote the fish and educate consumers in its preparation and handling to ensure and optimised eating experience.

Overall, Australian salmon represents an underutilised resource and an opportunity for providing high quality seafood to the Australian domestic market.

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Appendix 1: Recruitment

Pre-screening Questionnaire for Fish Sensory

NOTE: you must be over 18 to participate in this study

Name:_____ Gender: Male / Female

Contact Phone (Office Hours): _____

Country of birth: _____

Please tick the one that applies:

Age: 18-25 ☐ 26-35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56+ ☐

Availability

To participate in this study you need to attend **TWO** sessions. Please indicate your preferred time slots in the table below

	15th December	16th December	17th December
10 to 10:30 am			
10:30 to 11am			
11 to 11:30 am			
11:30 to 12 pm			
12 to 12:30 pm			
BREAK			
1:00 to 1:30 pm			
1:30 to 2 pm			
2:00 to 2:30 pm			
2:30 to 3 pm			
3:00 to 3:30 pm			
3:30 to 4 pm			
4:00 to 4:30 pm			

Health:

Do you have any of the following?

Dentures: Yes ☐ No ☐

Food Allergies: Yes ☐ No ☐

Oral or gum disease: Yes ☐ No ☐

Frequent head colds: Yes ☐ No ☐

Are currently pregnant: Yes ☐ No ☐

Are you a smoker? If yes, approximately how many cigarettes per day would you smoke? _____

Do you take any medications that affect your senses, especially your sense of touch or oral sensitivity? _____

Food Habits:

Are you currently on a restricted diet? If yes, explain _____

_____

How frequently do you eat fish?

never ☐ monthly ☐ once a fortnight ☐ once a week ☐ more often ☐

What is your favourite seafood?

_____

What is your favourite type of fish?

_____

Please return this form to **sensory@curtin.edu.au** or by internal mail to Dr Hannah Williams School of Public Health, Building 400.

You will be contacted to confirm your session time(s). Thank you!!

Do you eat fish?

Attend TWO x 20 minute (max) sensory evaluation sessions of fish and go in the draw to win a $150 vouchers redeemable at Kailis Bros Fish Market and Café, Leederville

Sensory sessions will run on the 15th, 16th and 17th at the following times :

10 to 10:30 am
10:30 to 11 am
11 to 11:30 am
11:30 to 12 pm
12 to 12:30 pm
BREAK
1:00 to 1:30 pm
1:30 to 2 pm
2:00 to 2:30 pm
2:30 to 3 pm
3:00 to 3:30 pm
3:30 to 4 pm
4:00 to 4:30 pm

All participants will automatically receive a small thank you gift (chocolate, tea/coffee packs, fruit packs etc).

This project has been approved by the Curtin University Human Research Ethics Committee, (Approval number SPH-08-2010)

Fish Consumer Evaluation Focus Group Informed Consent

The aim of this project is to evaluate consumer acceptability of selected fish species.

The purpose of the sessions is to determine what consumers (you) think is important when choosing which fish to purchase.

As you are going to be eating seafood there is the potential for allergic reactions. Therefore in order to participate in this study you must be over 18 years of age and have NO KNOWN ALLERGIES. By signing this form you declare you meet these conditions.

You will attend one focus group discussion for one to one and a half hours in the Sensory suite of the Food Science and Technology Program at Curtin University, Building 400 Level 1, Kent St, Bentley, WA 6102 between the 25th October and 5th November 2010.

Any of your personal information that is recorded will be used solely for administrative purposes and will not be included in any report or written communications arising from this project.

You are free to withdraw from the research at any point in time with no penalty.

This project has been approved by the Curtin University Human Research Ethics Committee, (Approval number SPH-08-2010) However if you have any complaints please contact the Secretary of the Human Research Ethics Committee (phone: 9266 2784 or hrec@curtin.edu.au or in writing C/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth WA 6845).

The Principal Investigator is DR Hannah Williams. For further information she may be contacted by ph (08) 9266 3329 or email h.williams@curtin.edu.au

I have read and understood this Informed Consent document and conditions of this project. I have had all my questions answered. I agree to participate in the fish sensory evaluation and to abide by the conditions requested.

(Full name)_____ (Signature)_____

(Date)_____

Fish Consumer Evaluation Sensory Informed Consent

The aim of this project is to evaluate consumer acceptability of selected fish species.

As you are going to be eating seafood there is the potential for allergic reactions. Therefore in order to participate in this study you must be over 18 years of age and have NO KNOWN ALLERGIES. By signing this form you declare you meet these conditions.

You will attend **two sensory evaluation** sessions in the Sensory suite of the Food Science and Technology Program at Curtin University, Building 400 Level 1, Kent St, Bentley, WA 6102 between the 15th and 17th December 2010. In each session you will be given four samples of cooked fish to taste. For each sample you will be asked to rate the acceptability of the fish attributes using a sensory evaluation form comprised of a series of linear scales. The tests should take between 15 and 20 minutes for each session. The research is interested in YOUR personal opinion of the fish samples you taste.

The completed sensory form will not contain any of your personal data. Any of your personal information that is recorded will be used solely for administrative purposes and will not be included in any report or written communications arising from this project.

You are free to withdraw from the research at any point in time with no penalty.

This project has been approved by the Curtin University Human Research Ethics Committee, (Approval number SPH-08-2010) However if you have any queries or complaints please contact the Secretary of the Human Research Ethics Committee (phone: 9266 2784 or hrec@curtin.edu.au or in writing C/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth WA 6845).

The Principal Investigator is DR Hannah Williams. For further information she may be contacted by ph (08) 9266 3329 or email h.williams@curtin.edu.au

I have read and understood this Informed Consent document and conditions of this project. I have had all my questions answered. I agree to participate in the fish sensory evaluation and to abide by the conditions requested.

(Full name)_____ (Signature)_____

(Date)_____

Appendix 2: Focus groups

Seafood questionnaire

Below are 10 questions about seafood habits and knowledge. It would be very helpful if you could response to every question. All data is anonymous and will be analysed as group response. Thank you!

Q1. How often do you purchase fish from each of the following locations?

	More than once per week	About once a week	About once a fortnight	About once every 3 weeks	About once per month	About once or twice a year	Never
• Supermarket							
• Fishmonger/Fish shop							
• Fish and chip shop							
• Markets							
• Restaurant/cafe							

Q2. Where do you purchase fish most often? (select one)

- Supermarket ☐
- Fishmonger/Fish shop ☐
- Fish and chip shop ☐
- Markets ☐
- Restaurant/cafe ☐

Q3. How often do you eat fish?

More than once per week	About once a week	About once a fortnight	About once every 3 weeks	About once per month	Less frequently

Q4. Which of the following types of fish products do you regularly buy to cook at home?

- Uncoated Fresh/Chilled Whole Fish or Fillets ☐
- Coated Frozen Fish Fillets ☐
- Coated Fresh/Chilled Whole Fish or Fillets ☐
- Frozen Fish Products (eg. fish cakes, fingers) ☐
- Uncoated Frozen Whole Fish or Fillets ☐
- Fresh/Chilled Fish Products (eg. fish cakes, fingers) ☐
- None of the above ☐

Q5. Which of the following types of fish are you aware of?

- Atlantic salmon ☐
- Australian salmon ☐
- Basa ☐
- Barramundi ☐
- Black Bream ☐
- Coral Trout ☐
- Cobbler ☐
- None of the above ☐
- Dory ☐
- Flat Head ☐
- Goldband snapper ☐
- Hake ☐
- Hoki ☐
- Mullet ☐
- Ocean Trout ☐
- Perch ☐
- Snapper ☐
- Red Emperor ☐
- Spanish Mackerel ☐
- Shark ☐
- Sword Fish ☐
- Whiting ☐

Q6. Which of the following types of fish have you ever bought?

- Atlantic salmon ☐
- Australian salmon ☐
- Basa ☐
- Barramundi ☐
- Black Bream ☐
- Coral Trout ☐
- Cobbler ☐
- Dory ☐
- Flat Head ☐
- Goldband snapper ☐
- Hake ☐
- Hoki ☐
- Mullet ☐
- Ocean Trout ☐
- Perch ☐
- Snapper ☐
- Red Emperor ☐
- Spanish Mackerel ☐
- Shark ☐
- Sword Fish ☐
- Whiting ☐

- None of the above ☐

Q7. Which of the following types of fish do you regularly buy?

- Atlantic salmon ☐
- Australian salmon ☐
- Basa ☐
- Barramundi ☐
- Black Bream ☐
- Coral Trout ☐
- Cobbler ☐
- Dory ☐
- Flat Head ☐
- Goldband snapper ☐
- Hake ☐
- Hoki ☐
- Mullet ☐
- Ocean Trout ☐
- Perch ☐
- Snapper ☐
- Red Emperor ☐
- Spanish Mackerel ☐
- Shark ☐
- Sword Fish ☐
- Whiting ☐

- None of the above ☐
- Other : (please specify): _____

Q8. Which of the following types of fish would you never consider purchasing?

- Atlantic salmon ☐
- Australian salmon ☐
- Basa ☐
- Barramundi ☐
- Black Bream ☐
- Coral Trout ☐
- Cobbler ☐
- Dory ☐
- Flat Head ☐
- Goldband snapper ☐
- Hake ☐
- Hoki ☐
- Mullet ☐
- Ocean Trout ☐
- Perch ☐
- Snapper ☐
- Red Emperor ☐
- Spanish Mackerel ☐
- Shark ☐
- Sword Fish ☐
- Whiting ☐

- None of the above ☐
- Other : (please specify): _____

Q9. Who in your household eats fish?

- Children under 12 years ☐
- Teenagers 13-17 years ☐
- Males 18-25 years ☐
- Females 18-25 years ☐
- Males 26-35 years ☐
- Females 26-35 years ☐
- Males 36-45 years ☐
- Females 36-45 years ☐
- Males 46-60 years ☐
- Females 46-60 years ☐
- Males over 60 years ☐
- Females over 60 years ☐

Q10. Thinking specifically about fresh / chilled fish, how do you normally cook fish at home?

- Pan Fry ☐
- Grill ☐
- Bake ☐
- BBQ ☐
- As an ingredient in a dish (i.e. Pasta, rice, pie, soup) ☐
- Steam ☐
- Poach ☐
- I eat fish raw ☐
- Asian cooking ☐
- Green curry ☐
- Smoked ☐
- Other?(Please specify) _____

You have now completed the survey!!!

Appendix 3: Sensory evaluation of Fish

Panellist Code: _____ Date: _____

Session code: _____

You have been given **four** samples to evaluate. Please assess the sample on the left first and then record your degree of liking for each of the five characteristics on the separate scales given. To record your evaluation, place a **horizontal straight line** at the position on the line scale that matches your degree of liking for that characteristic for that sample, then label the mark with the sample's three digit code as shown in the example.

Please take a drink of juice to cleanse your palate before proceeding to evaluate the second sample.

Repeat these steps until all four samples have been evaluated for all five characteristics.

Example: