



Applying the triangle taste test to wild and cultured humpback grouper (*Cromileptes altivelis*) in the Hong Kong market

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Introduction

Live reef fish are regarded as premium fish for consumption in Southeast Asia and China, and higher value species are principally consumed in restaurants. With the economic growth in Hong Kong during the last 30 years, the demand for live reef fish has increased substantially. It is estimated that imports into Hong Kong account for about 60% of the volume of live reef fish traded in the Asia-Pacific region (Sadovy et al. 2003). Recent estimates show that the declared annual volume of live reef fish imported into Hong Kong is 12,000–14,000 tonnes, with a retail value of about 350 million US dollars (USD) (Muldoon et al. 2005).

There are concerns that the high demand for live reef fish has led to overexploitation of fish stocks and damage to coral reefs (Cesar et al. 2000; Sadovy et al. 2003). Practices used in fisheries for live reef fish, such as the use of destructive harvesting techniques, including cyanide fishing, and the targeting of spawning aggregations and juvenile fish, damage the marine ecosystem and threaten the sustainability of the supply of reef fish.

Because the supply of wild-caught fish from reefs is under pressure, the potential to supplement wild-caught supply with aquaculture production is considered important for the long-term sustainability of the trade. Aquaculture production of grouper species is now expanding rapidly, increasing at an average of 43% per year from 1999 to 2002 (Rimmer et al. 2006). Consumer acceptability of cultured product is obviously an important factor in terms of the degree to which cultured product can displace wild product on the market and thereby help ensure the persistence of wild stocks. We need to better understand consumers' preferences for live reef fish, particularly with respect to cultured versus wild fish.

The Australian Centre for International Agricultural Research (ACIAR) is funding research aimed

at ensuring the sustainable economic development of the trade. As part of this research, two projects related to consumer preferences for live reef fish in Hong Kong were undertaken during December 2005. One was a survey of consumer attitudes related to the consumption of live reef fish (Chan et al. 2006). The other was a taste test that aimed to determine whether consumers could discriminate between wild and cultured samples of a particular species of live reef fish in a "blind" situation (i.e. in which the tasters do not know which product they are tasting), and to examine which product attributes they prefer. This latter project is reported on here.

Methodology

There are a number of taste test techniques, such as pair comparison and contingent ranking, which were applied by The Nature Conservancy on cultured and wild-caught malabar grouper (*Epinephelus malabaricus*) (OmniTrak 1997). The triangle test technique was selected for this study because it is the most widely used discriminative test in sensory analysis, which has the aim of determining whether or not detectable differences exist between two samples (Huss 1995). In the triangle taste test, assessors receive three coded samples of fish. They are told, accurately, that two of the fish samples come from the same type of fish and that one is different, and are asked to identify the odd sample. These tests can be useful in determining whether consumers can detect sensory differences between cultured and wild fish products.

In the test, humpback grouper (*Cromileptes altivelis*) was selected as the taste test product (Fig. 1). Humpback grouper is a highly valued fish in the Hong Kong market, selling for approximately USD 83 per kilogram in Chinese seafood restaurants in Hong Kong. The wild-caught humpback groupers were supplied from Indonesia through a Hong Kong trader, while the cultured humpback

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groupers were supplied from the Gondol Research Institute for Mariculture (GRIM) in Bali, Indonesia. All the tested fish were of typical market size: 0.6 to 1 kilogram.

In the original test design, two types of cultured products were to be included for comparison with a wild-caught product. Both of the cultured humpback grouper products were raised from full-cycle aquaculture but one was fed “trash fish”, which is usually smaller sized species of low value, while the other was grown out on fish pellets, which consist of a scientifically formulated feed of fish meal and vegetable products. Unfortunately, the two types of cultured humpback grouper products were mixed together during transportation to the restaurant. It was consequently necessary to modify the taste test to solely compare wild-caught and cultured humpback groupers, without discrimination between the two types of feeding regimes.



Figure 1. Humpback groupers used in the taste test, swimming in a restaurant tank, November 2006, Hong Kong (photo by B.G. Johnston).

Thirty participants were recruited for the taste test: 16 were guests invited by the Hong Kong Chamber of Seafood Merchants (HKCSM), mostly merchants involved in the trade, and 14 were staff from local seafood restaurants.

The taste test was carried out in a Chinese seafood restaurant whose staff was highly skilled in preparing live reef fish for restaurant meals (Fig. 2). The fish were prepared in the manner typical of such meals. The fish were cut into pieces so that the assessors could not see the whole fish. Each assessor was given one bowl of each of the three fish samples. They were told that two of the bowls came from the same source, while one of the bowls was different. They were not told whether the odd sample was a wild-caught or a cultured sample, as illustrated in Figure 3. Although there were two types

of cultured fish, each assessor was given only one of the two types to compare with the wild-caught sample. Each assessor sat at his or her own table and was asked not to converse with the assessors at adjacent tables.



Figure 2. Restaurant placement setting for the taste test, Hong Kong (photo by B.G. Johnston).

Triangle taste test: wild versus cultured fish

In the 3 bowls of fish, two of them come from the same kind of humpback grouper, one is different. After tasting, please identify the odd one. Please provide ONE answer only. If you are not sure, please guess the odd one.

1 2 3

Figure 3. Sample triangle taste test questionnaire.

The taste test included three parts. First, assessors were asked to taste the samples, identify the odd one and identify the key sensory characteristics that made it different. Second, they were asked to identify the sample they preferred for each of five specific listed attributes: colour, taste, texture (smoothness), texture (elasticity) and skin. Third, they were asked to guess which samples were wild and which were cultured.

Results

In Test 1, 53% of assessors were able to correctly identify the odd samples (Fig. 4). In terms of the assessors who were live reef fish traders (the HKCSM guests) versus those who were not (the seafood restaurant workers), 44% of the former group correctly identified the odd samples, compared with 64% of the latter group.

In Test 2, it was found that most respondents preferred the sample of wild humpback grouper over the cultured product in all five of the sensory attributes (Fig. 5). Among those participants who were able to correctly discriminate between the wild-caught and cultured products (16 assessors; see Fig. 4), it was found that for all five attributes, most preferred the wild-caught product to the cultured product (Fig. 6).

In a triangle test, assessors can, even if they cannot discriminate among the samples, utilise random guessing to identify the odd sample. Therefore, in part 3 of the test, assessors were asked to describe the sample combination; that is, to indicate for each of the three fish samples whether it came from a wild or cultured source. It was found that 37% (11 assessors) were able to correctly identify their sample combinations (Fig. 7). Thirty-one percent of traders and 43% of non-traders did so correctly. Because Test 3 is more difficult (in terms of the probability of being correct by chance alone) than Test 1, we would expect the percentage of correct answers to be lower in Test 3 than in Test 1, as they were.

We further analyzed the attribute preferences of those respondents who correctly identified the sample combinations in Test 3 (11 assessors; see Fig. 7). It was found that all of them preferred the wild sample over the cultured one in colour, taste and texture (smoothness) (Fig. 8). However, for the texture (elasticity) attribute one person in this group preferred the cultured sample and another expressed indifference between the cultured and wild products, and for the skin attribute one person preferred the cultured product and two expressed indifference.

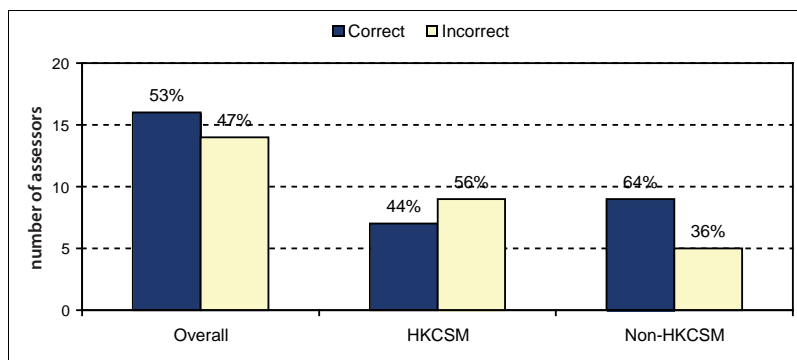


Figure 4. Number and percent of assessors that correctly identified the odd sample.

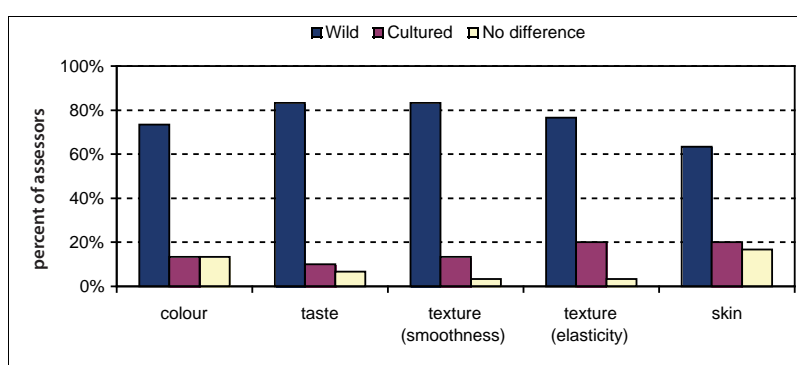


Figure 5. Preferences between wild and cultured products, by attribute.

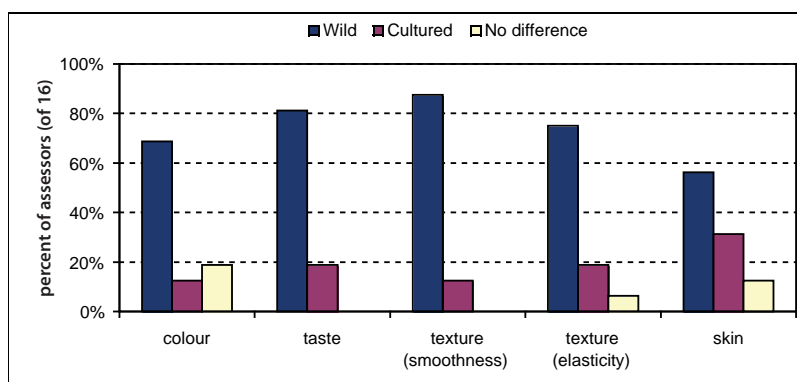


Figure 6. Preferences between wild and cultured products, by attribute, among the 16 assessors who correctly identified the odd sample.

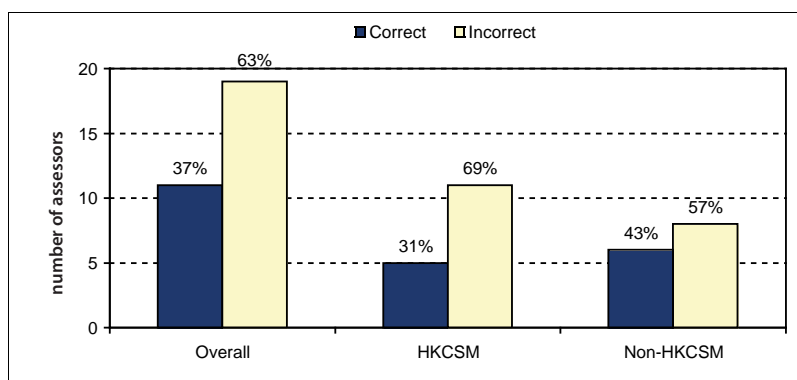


Figure 7. Success in identifying sample combinations.

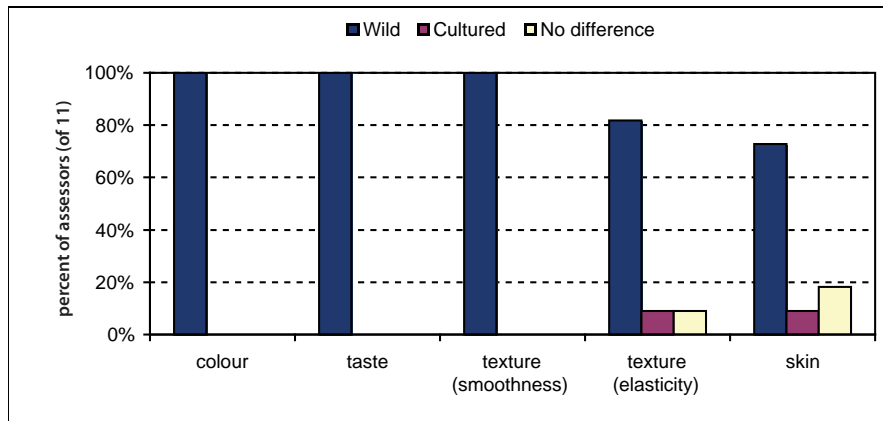


Figure 8. Preferences between wild and cultured products, by attribute, among the 11 assessors who correctly identified the sample combination.

Discussion

Overall, the triangle test methodology worked well and all participants were able to complete the test. They also provided positive feedback that suggests this methodology can be applied to assess the quality of cultured fish of other species in order to objectively test the widely perceived perception that cultured fish are of inferior quality relative to wild-caught fish.

The results indicated that there was a definite preference among participants for the colour, taste and texture of the wild-caught product (more than 70% preferred the wild-caught product in these attributes). However, informal feedback from participants after the test indicated that the cultured product was also highly acceptable to participants. This bodes well for the widespread commercial acceptance of cultured products in the future.

There were some aspects of the triangle taste test that we would do differently in the future. First, the cultured fish comprised two types (trash fish-fed and pellet-fed), but it was not possible to test for differences between them. It would be desirable to test the two types of cultured fish separately in future tests to ascertain whether there are preferences for trash fish-fed or pellet-fed products.

Also, it would be desirable to broaden the sample to include a larger group of more typical consumers of live reef fish, rather than relying on individuals involved in the industry to provide assessments. The blind triangle taste test methodology worked well in a restaurant setting and could be easily extended to a larger and more representative sample in the future. It would also be useful to evaluate the visual

aspects of the fish swimming in the restaurant tanks to ascertain whether consumers can discriminate between wild and cultured products when choosing the fish to consume in the restaurant.

At the completion of the taste test, in an open discussion, the seafood merchants offered a number of comments that might be valuable to aquaculture scientists and marketers of cultured fish.

- Many merchants thought there was a very good future for cultured live reef fish in the market in Hong Kong.
- The taste and texture of cultured fish is already considered quite acceptable to Hong Kong consumers, although it currently trades at a discount price relative to wild-caught product (the size of this discount varies across species and will require further market research to determine).
- Among the higher value species that are available from culture (which appear to only include humpback grouper and giant grouper, *Epinephelus lanceolatus*, at this time), the trade appears to be favouring giant grouper. It grows to market size relatively quickly, appears to be a more robust species for cage culture, and its flavour and texture appear to be well accepted. A merchant familiar with both cultured humpback grouper and cultured giant grouper said that the best tasting and textured cultured live reef fish was giant grouper from Taiwan raised on pellets.
- Individuals involved in the trade in live reef fish are highly aware of environmental and health issues associated with the trade. The import into Hong Kong of groupers raised with the applica-

tion of malachite green has heightened consumer awareness of the need to purchase healthy and safe fish, and the industry is responding to this issue. The Hong Kong aquaculture industry has been cooperating with Hong Kong's Agriculture, Fisheries and Conservation Department to introduce a Certified Fish Tag Scheme (Sun 2005) in which fish farms that comply with certain conditions, such as criteria related to pond size, drainage, source of water and protection from contamination, and that submit to regular government checks, can place a certifying tag on their fish at the point of sale in the market. The tag is fixed to the fin of the fish and is designed to be tamper-proof.

- Individuals involved in the trade are aware that overfishing has been occurring in wild populations and that future supplies of wild-caught live reef fish will be more limited. They consequently see the aquaculture sector as providing future growth opportunities for the trade.

Conclusions

The blind triangle taste test showed that most participants in this study could discriminate between wild and cultured fish samples in a "blind" situation and that the wild-caught product was preferred in most sensory attributes. The blind triangle taste test methodology was found to be a suitable method for assessing perceived taste differences in live reef fish products.

Some valuable lessons were learned from the test, including the need to protect the integrity of the samples being tested from the point of production through to the restaurant tank.

Future triangle taste tests of live reef fish products should test for differences in preferences and product attributes between cultured products produced from different food sources (trash fish versus pellets). They should also include a more representative sample of typical Hong Kong consumers to complement the "expert panel" approach used in this study.

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