

Full Length Research Paper

## Sensory evaluation of wild-captured and pond-raised Tilapias in Malawi

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A sensory evaluation study was carried out to answer the question: "Are pond raised fish inferior to wild fish?" Lake Malawi Chambo - Tilapia (*Oreochromis karongae*) and Shire River Tilapia (*Oreochromis shiranus*) were processed into various products. Panelists evaluated preferences of the fish based on four sensory attributes namely: flavour, smell, taste and texture using a blind sample scoring. Results demonstrated that consumers were indifferent in their preference for fish from the wild and pond raised ( $P>0.05$ ) suggesting that processed fish from both sources are equally liked. Acceptability of wild and pond raised *O. karongae* increased for processed products ( $P<0.05$ ) while processed *O. shiranus* was liked indifferently irrespective of source ( $P>0.05$ ). The study concludes that the disparity that consumers have regarding preference between wild and pond raised tilapia could merely be subjective, and hence, rejecting the hypothesis that pond raised fish are inferior to wild fish. A further observation is that presenting pond raised fish in a processed form could help in removing consumer bias consistent with sensory acceptability of food thereby improving its marketability and consequently, profitability. Processing also aids in value adding to realize more economic and nutritional benefits from fish. Findings from this study could be useful in planning and designing efficient marketing strategies for promotion of farmed fish.

**Key words:** *Oreochromis karongae*, *Oreochromis shiranus*, consumer behavior, fish presentation, unprocessed fish.

### INTRODUCTION

Tilapias are the most important and commonest farmed fish species in Malawi due to the ease of management. They require cheap and locally available feed hence mostly raised by small scale and low income farmers.

The experimental fish in this study, *Oreochromis shiranus* and *O. karongae* are two of the four tilapia species for aquaculture in Malawi, others being *O. mossambicus* and *Tilapia rendalli*. Though fish production from aquaculture

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is growing at an increasing rate due to many factors such as the declining catches from the wild versus increasing population, pond raised fish still receive a comparatively low rating from consumers than wild fish. There is a widely accepted traditional belief among consumers in Malawi (pers. obs) and elsewhere (Gaviglio and Demartini, 2009; Vanhonacker et al., 2013; Claret et al., 2012, 2014) that farmed fish do not taste as good as fish from the wild and also that fish from ponds have a muddy smell.

The general consumer attitude and myths is that pond raised fish are inferior to lake (wild) fish also reported by Schlag and Ystgaard (2013). Such assertions are counterproductive because consumer acceptance is crucial for market success of aquaculture produce (Vanhonacker et al., 2013). Pond raised fish thus, attract lower market prices than fish from the wild and hence removing the incentive of investing into commercial aquaculture in Malawi. It is known nevertheless, that knowledge about a product is the major motivational factor for purchasing functional foods (Frewer et al., 2003), while lack of knowledge is the major reason of not consuming functional foods (IFIC, 1999). Claret et al. (2014) noted that people perceive clear differences between farmed and wild fish and, that beliefs related to quality favor wild fish, while those related to availability and price favor farmed fish. This is the pattern of challenges also reported by Schlag and Ystgaard (2013) that when consumers only consider non-scientific concerns such as trust and nature, they prefer wild to farmed fish. That explains why consumer preference of farmed fish products may hinder production and marketing of fish from aquaculture. The reason given is that consumers have less trust in the production and consumption of farmed fish than in wild fish, perceiving the former as unnatural and unfamiliar. Schlag and Ystgaard (2013) suggests that it is imperative to incorporate moral and ethical risk dimensions in communication because these are the important aspects that influence consumer preference of wild over farmed fish.

This study was therefore carried out to compare consumer preferences between processed products from two indigenous tilapia fish species collected from the wild (lake) and pond raised.

## MATERIALS AND METHODS

### Preparation of recipes

The study used fish of average weight 150 g. *O. karongae* (Lake Malawi Chambo) and *O. shiranus* (Shire River tilapia) were obtained from Lake Malawi and Bunda College Aquaculture Fish ponds, respectively. The fish were washed in clean water, scaled and eviscerated and prepared as meatballs, fillets and whole fish cut into pieces which were later deep fried in edible cooking vegetable oil. Some of the cut pieces were boiled.

### Sensory evaluation

A total of pre-trained 30 panelists (college students) of ages between 19 and 24 were invited to carry out a sensory evaluation of the prepared fish recipes and indicate their preferences on four sensory attributes namely: taste, color, flavor and texture. After training and pre-testing, panelists were screened based on their consistency to score the samples. Recipes were arranged on tables in a Nutrition Laboratory assigned blind random codes such as A, X, C, W etc. covering all samples to avoid bias. Each panelist was asked to taste each recipe by rinsing their mouths with water before and after each taste (Oduor-Odote et al., 2010; Daramola et al., 2007), as well as using a different fork between tastes to avoid interactions of the sensory characteristics. Panelists explained their sensory judgments by way of filling a designed form after the tasting and before moving on to the next sample (recipe) from the hedonic scale. The scores on the hedonic scale ranged from 1-5 as 1 = Dislike extremely, 2 = Dislike moderately, 3 = Neither like nor dislike, 4 = Like moderately and 5 = Like extremely.

### Ethical considerations

In order to adhere to consumer ethical conduct regarding eating of foods, panelists were well informed about the type of fish species which they would taste and the source of the fish including the mode of processing e.g. the type of cooking oil used. Panelists therefore freely accepted to be part of the study with full knowledge of the process.

### Data analysis

Data were analyzed using SPSS for Windows version 15.0. Descriptive statistics: frequencies, percentages, and means were used to report the data. Sample means were compared using one way analysis of variance (ANOVA) at 5% level of significance.

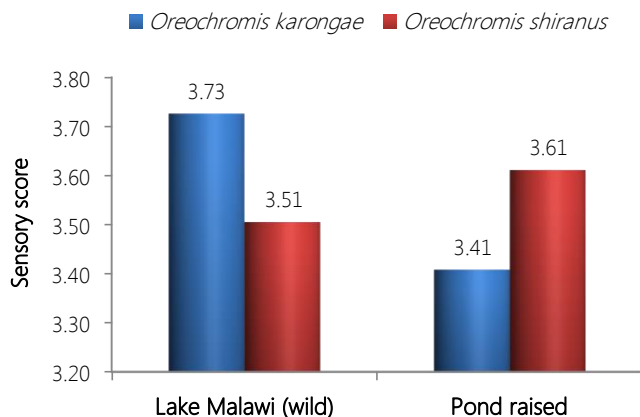
## RESULTS

Mean sensory scores for lake (wild) and pond raised *O. karongae* and *O. shiranus* are  $3.726 \pm 0.023$ ,  $3.408 \pm 0.0129$ ;  $3.505 \pm 0.006$  and  $3.611 \pm 0.020$  respectively (Figure 1).

Results show significant differences ( $P < 0.05$ ) in consumer preference between wild and farmed *O. karongae* (Tables 1 and 2; Figures 2 and 3). *O. shiranus* was liked indifferently irrespective of source ( $P > 0.05$ ) (Figure 2). It was also observed that when *O. shiranus* was processed, consumer preference in flavor, smell, taste and texture did not differ ( $P > 0.05$ ) between fish collected from the wild and pond raised. Meat balls and fillets from pond raised *O. shiranus* were favoured more compared to wild fish ( $P < 0.05$ ) (Table 1).

Significant differences ( $P < 0.05$ ) were observed in flavor and taste between wild and pond raised *O. karongae* but no differences in smell and texture ( $P > 0.05$ ) (Figure 3).

Smell, flavour and taste did not contribute much to consumer preference of wild *O. karongae* ( $P > 0.05$ ) while texture was the main driver for such ( $P < 0.05$ ). For pond raised *O. karongae*, consumer preference was mainly



**Figure 1.** Mean sensory scores for wild and pond raised *Oreochromis karongae* and *Oreochromis shiranus*.

**Table 1.** Mean sensory scores for processed wild and pond raised *Oreochromis shiranus*.

Type of product	Source	Sensory score			
		Taste	Flavour	Smell	Texture
Boiled	Wild	3.96±0.16 <sup>a</sup>	4.00±0.15 <sup>a</sup>	3.82±0.17 <sup>a</sup>	3.96±0.20 <sup>a</sup>
Boiled	Pond	3.55±0.21 <sup>b</sup>	3.51±0.18 <sup>b</sup>	3.58±0.18 <sup>b</sup>	3.86±0.20 <sup>a</sup>
Fried	Wild	3.88±0.21 <sup>a</sup>	3.88±0.19 <sup>a</sup>	3.44±0.18 <sup>a</sup>	3.88±0.21 <sup>a</sup>
Fried	Pond	3.41±0.22 <sup>b</sup>	3.55±0.24 <sup>b</sup>	3.44±0.20 <sup>a</sup>	3.72±0.24 <sup>b</sup>
Meat balls	Wild	2.73±0.23 <sup>b</sup>	2.80±0.22 <sup>a</sup>	2.63±0.20 <sup>a</sup>	2.96±0.22 <sup>a</sup>
Meat balls	Pond	2.75±0.24 <sup>a</sup>	2.55±0.17 <sup>b</sup>	2.55±0.18 <sup>b</sup>	2.58±0.23 <sup>b</sup>
Filleted	Wild	4.35±0.10 <sup>a</sup>	4.10±0.16 <sup>a</sup>	3.96±0.21 <sup>a</sup>	3.96±0.20 <sup>a</sup>
Filleted	Pond	4.06±0.17 <sup>b</sup>	3.86±0.19 <sup>b</sup>	3.93±0.16 <sup>b</sup>	3.86±0.19 <sup>b</sup>

Means with same superscript in a column are significantly not different ( $P>0.05$ ).

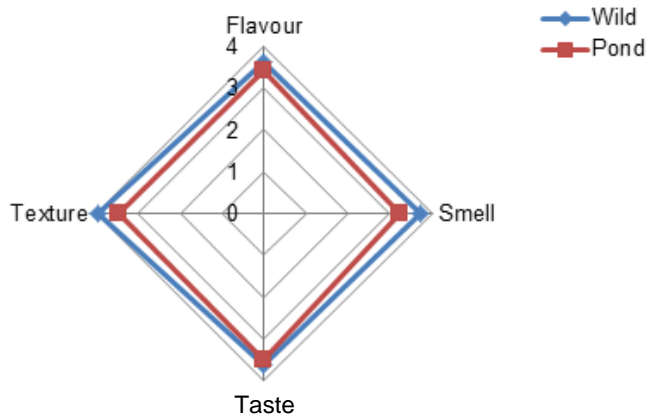
**Table 2.** Mean sensory scores for processed wild and pond raised *Oreochromis karongae*.

Type of product	Source	Sensory score			
		Taste	Flavour	Smell	Texture
Boiled	Wild	3.75±0.16 <sup>b</sup>	3.62±0.21 <sup>b</sup>	3.27±0.15 <sup>b</sup>	3.68±0.18 <sup>b</sup>
Boiled	Pond	4.32±0.18 <sup>a</sup>	4.25±0.20 <sup>a</sup>	4.32±0.17 <sup>a</sup>	4.39±0.18 <sup>a</sup>
Fried	Wild	3.55±0.21 <sup>b</sup>	3.42±0.20 <sup>b</sup>	3.29±0.20 <sup>b</sup>	3.32±0.21 <sup>b</sup>
Fried	Pond	3.75±0.22 <sup>a</sup>	3.60±0.21 <sup>a</sup>	3.60±0.19 <sup>a</sup>	3.92±0.19 <sup>a</sup>
Meat balls	Wild	2.24±0.19 <sup>a</sup>	2.44±0.19 <sup>a</sup>	2.93±0.20 <sup>a</sup>	2.93±0.23 <sup>a</sup>
Meat balls	Pond	2.06±0.17 <sup>a</sup>	2.31±0.19 <sup>a</sup>	2.24±0.14 <sup>b</sup>	2.82±0.22 <sup>a</sup>
Filleted	Wild	4.13±0.16 <sup>b</sup>	4.06±0.19 <sup>b</sup>	3.96±0.18 <sup>b</sup>	4.37±0.10 <sup>a</sup>
Filleted	Pond	4.62±0.15 <sup>a</sup>	4.44±0.13 <sup>a</sup>	4.10±0.18 <sup>a</sup>	4.10±0.20 <sup>b</sup>

Means for the same product with same superscript in a column are significantly not different ( $P>0.05$ ).

influenced by taste, texture and flavour but not smell. Consumers neither liked nor disliked the smell/odor of wild and pond raised *O. karongae* (kite is pulled inside –

Figure 3). Without blind scoring, pond raised *O. karongae* would be rated low compared to wild. Interestingly, consumers highly liked the taste of pond raised *O.*



**Figure 2.** Consumer mean sensory scores for wild and pond raised *Oreochromis shiranus* flavor, smell, taste and texture.



**Figure 3.** Consumer mean sensory scores for wild and pond raised *Oreochromis karongae*.

*karongae* (kite pulled outside - Figure 3) but were indifferent for wild *O. karongae*. With an exception of meat balls, boiled, fried and filleted pond raised *O. karongae* was significantly liked in all organoleptic attributes ( $P < 0.05$ ) (Table 2).

Overall results nevertheless, show no significant differences in consumer preference between wild and pond raised fish ( $P > 0.05$ ). The overall mean for all the sensory attributes was closer to 4 suggesting that the panelists liked moderately fish irrespective of the source from which they were collected.

**DISCUSSION**

If presented unprocessed, pond raised *O. shiranus* would

by far be out competed by the Lake Malawi Chambo (*O.s karongae*) because of its inferior appearance. A similar observation was reported by Gebrezgabher et al. (2015) that farm raised fish only attracted consumers in processed form. The fact that processed *O. shiranus* was liked indifferently irrespective of source (wild or pond), agrees with Costell et al. (2010) that consumer perception of food products and its acceptance or rejection is of a multi-factorial nature. Sensory characteristics present the strongest driver of fish consumption as well as one of the main barriers for acceptance of farmed fish (Claret et al., 2016). For example, Gaviglio and Demartini (2009) reported that a majority of the respondents thought that wild-caught product tastes better than farm-raised ones while yet others admitted not being able to distinguish the origin of fish by taste alone. This has been suggested to be one of the most common prejudices connected to farm-raised products. Similar findings have been reported by previous workers (Verbeke et al., 2007) that majority of the consumers do not perceive any differences between farmed versus wild fish concluding that consumers have difficulties in evaluating the quality of fish products. Possibly, this could point to the difficulty in explaining why consumer preference between wild and pond raised *O. karongae* was different while *O. shiranus* was liked indifferently irrespective of source. It is also not easy to provide an explanation for no differences in taste between wild and pond raised *O. karongae* but differences in taste and flavor. The multi-factorial nature of consumer food acceptance and rejection (Costell et al., 2010) and other factors may also have played a role for example, variations in the assessors' ability to judge the fish recipes. Disorders of taste and smell have proved difficult to diagnose and treat, often because of a lack of knowledge and understanding of these senses (<http://emedicine.medscape.com/article/861242/overview>). For example, one of the concerns reported by Lawless (1999) is whether odors and their mixtures are perceived as unitary or analyzable percepts. FAO (1998) stresses the need to assess the panelists before any sensory evaluation exercise. Notable areas of concern include but not least, whether the assessor is not anosmic (unable to perceive odors) - so that odors of decomposition and other defects will be perceived and described in a consistent manner. The assessor should also not be ageusic (unable to perceive basic tastes) - so that tastes associated with decomposition and other defects will be perceived and described in a consistent manner. These and many more attributes make sensory difficult and highly subjective. Kapute et al. (2012) observed that product declared unfit for consumption through sensory evaluation may still be nutritionally good. Overall results nevertheless, showed that there were no significant differences in consumer preference between wild and farmed (pond) fish suggesting that consumers

liked the fish moderately irrespective of the source from which they were collected. Results in this study agree with earlier reports where no significant differences were observed between wild and farmed fish (Jaffry et al., 2000; Vanhonacker et al., 2013; Claret et al., 2014). In fact, Vanhonacker et al. (2013) showed that fish origin does not seem to be a major issue or a criterion for differentiation and selection between wild and farmed fish. Apparently, this is contrary to what consumers would do without blind labeling of the samples. The assessment of blind-labeled product acceptability is one of the corner stone of sensory evaluation (Lawless and Heymann, 2010). Labeling which is usually by way of blind coding helps to remove subjectivity although it is known that blind coding of samples of products negatively biases taste perceptions and attitudes toward a food (Wansink et al., 2000). Consumer beliefs have significant influence regarding preference between farmed and wild fish. A generalized positive attitude towards wild fish appears to be the main driver of consumer beliefs about farmed versus wild fish. Claret et al. (2016) reported interesting findings that in the informed condition, participants preferred wild fish but scored the opposite when information was not provided to them. This suggests that consumers do not inherently dislike farmed fish.

## CONCLUSION AND RECOMMENDATIONS

We conclude based on the study findings that discrimination of pond raised fish in Malawi is largely subjectivity of the consumers due to beliefs and thus, pond raised fish are as good as fish from the wild (lake). The hypothesis that pond raised fish are inferior to wild fish is therefore rejected. Study findings confirm challenges of using sensory evaluation as a sole method for testing superiority of foods and in this context - fish. Changing mindset of consumers is not a straight away issue. Results have also demonstrated that one way of avoiding consumer bias in pond raised fish is by processing into varied products. It is suggested that fish farmers should endeavor to sell their pond raised fish processed to favourably compete with fish from the lake. This could also be a way of value adding to realize more economic and nutritional benefits from fish. Findings could be useful in planning and designing efficient marketing strategies for promoting farmed fish.

## Conflict of Interests

The authors have not declared any conflict of interest.

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