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# A COMPARISON OF GIFT AND RED TILAPIA FOR FILLET YIELD AND SENSORY ATTRIBUTES OF FLESH QUALITY ASSESSED BY A TRAINED PANEL

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## INTRODUCTION

Tilapia is a tropical freshwater fish, predicted to become the largest aquaculture production in the world, after carps, shrimp and salmonids, in the present century (Fitzsimmons, 2000). In Malaysia 85 per cent of the farmed Tilapia is Red Tilapia (*Oreochromis spp.*) (FAO, 2001), highly favoured by consumers due to its colour. GIFT (Genetically Improved Farmed Tilapia, *Oreochromis niloticus*) is an alternative to Red Tilapia. It is an improved strain developed by selective breeding (Eknath and Acosta, 1998), with a silvery grey colour and dark grey vertical bands along the entire body. GIFT has consistently outperformed other strains (Dey *et al.*, 2001), with an 85 per cent cumulative genetic gain in growth rate over five generations of selection in the Philippines reported by Eknath and Acosta (1998), and a further 10 per cent after its transfer to Malaysia (Ponzoni *et al.* 2005). Fillet yield and flesh quality have not been part of the breeding objective in GIFT, hence a comparison with the much preferred Red Tilapia appeared relevant. In this paper we report the results of two trials in which a trained panel assessed flesh quality attributes. In a separate paper (these Proceedings) we report the outcome of two trials involving the assessment of flesh quality by untrained consumers.

## MATERIAL AND METHODS

**The fish and the environment.** GIFT (G) were progeny of the generation born in 2002 at the Aquaculture Extension Center (Department of Fisheries), Jitra, Kedah State, Malaysia, where this trial was conducted. Red Tilapia were obtained from three sources : (i) The Aquaculture Extension Center (Department of Fisheries) at Enggor (E), Perak State ; (ii) the Freshwater Fisheries Centre, Batu Berendam, Melaka State (M), which provided stock to Jitra Aquaculture Extension Center in 2003, and (iii) a private farm called Tan Weng Hong Enterprise Sdn. Bhd., located at Seremban, Negeri Sembilan (NS) state. The experimental fish were generated by mass spawning 6 males and 18 females of each one of the four strains in hapas between 14 April and 18 May 2003. When the fingerlings were 7.5cm long they were fin clipped for strain identification purposes and communally reared in earthen ponds (0.05 ha) and cages (3m x 3m x 2.5m deep). There were three rearing treatments: (i) cage, with all the strains together; (ii) pond, all strains together; and (iii) cage, with only one strain per cage. There were three replicates of the two first mentioned treatments, whereas there were two for the latter one. The stocking densities were 55 and three fish per $m^2$ in cages and pond, respectively. The feeding regime followed Malaysian farm practice. Details on this and other aspects of the production system are given in Khaw *et al.* (2006). Harvest and trait recording took place in April 2004.

**Filleting and flesh quality assessment.** Filleting and the flesh quality (sensory) evaluation were both carried out at the Fisheries Research Institute (FRI), Department of Fisheries, Penang, Malaysia. The fish were randomly sampled from all the treatments, and filleted manually by two trained persons. The skinless fillets were weighed, cut into three portions, wrapped up in aluminium foil, and individually identified. For the sensory test, data from 48 and 130 fish were available, for trials 1 and 2, respectively (Table 1). These numbers were

determined by the panelists' ability to assess the fish in the time they were available. Twelve assessors were trained at FRI's laboratory designed for sensory evaluation, equipped with individual booths, standardized light, basin and drinking water for mouth cleansing between samples. The evaluation itself took place in the same laboratory. The skinless fillets were cooked for 15 minutes in a steamer. For trial 1 the samples were evaluated using a Quantitative Descriptive Analysis (QDA) score card, which has a 15 cm score line anchored with words signaling the lowest (0 cm) and highest (15 cm) perceived intensities for the following attributes: aroma for odor; colour for visual appearance; sweetness and juiciness for flavor; biting and chewing for texture in mouth; and acceptability for overall perception. The panelists marked each line according to their perception of each attribute. For trial 2 the evaluation was carried out as for trial 1, except that a simpler scoring procedure was used, ranging from one (low intensity) to five (high intensity) for each of the attributes. The logic behind the QDA approach and the methodology used in it are described by Stone *et al.* (1998).

**Table 1. Number of fish of each strain (G, E, M, NS) used in the sensory evaluation**

| Environment | | G | | E | | M | | NS | |
|---|---|---|---|---|---|---|---|---|---|
| Production | Social | Trial 1 | Trial 2 | Trial 1 | Trial 2 | Trial 1 | Trial 2 | Trial 1 | Trial 2 |
| Cage | Separate | 8 | 20 | 2 | 12 | 3 | 15 | 3 | |
| | Together | 8 | | 4 | | 1 | | 3 | |
| Pond | Together | 8 | 22 | 4 | 21 | | 19 | 4 | 21 |
| Total | | 24 | 42 | 10 | 33 | 4 | 34 | 10 | 21 |

**Statistical analysis.** The data were analyzed using SAS (SAS Institute Inc., 1997). Preliminary analyses were carried out to select suitable models for each data set and trait. Non-significant or meaningless interactions were deleted from the model. Analysis of variance was performed using PROC MIXED. In trial 1, strain, environment (production and social, see Table 1) and sex were fitted as fixed effects, whereas panelist was fitted as a random effect. The same model was used in trial 2, except that because sex was not recorded it could not be fitted.

## RESULTS AND DISCUSSION

Table 2 shows the least squares means for strains for both trials 1 and 2, for harvest weight and fillet yield and weight. Production and social environment effects were not statistically significant. Sex only had a significant effect on fillet weight (females>males). There were no significant differences among strains in trial 1, but for harvest weight in trial 2, where GIFT, E and NS strains did not differ from each other, but they all differed from the M strain. Table 3 shows the flesh quality traits least squares means, by strains, for both trials 1 and 2. Production and social environment effects were not statistically significant in the majority of the cases, and when they were, they were not consistent between trials. Sex did not have a significant effect for any of the traits.

**Table 2. Fish weight and fillet traits least squares means for strains**

| Strain | Harvest Weight | | Fillet Yield | | Fillet Weight [A] | |
|---|---|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 1 | Trial 2 | Trial 1 | Trial 2 |
| G | 595.8 | $558.1_{ab}$ | 33.5 | 31.3 | 138.5 | 169.6 |
| E | 581.9 | $551.2_{ab}$ | 33.3 | 31.3 | 136.7 | 169.6 |
| M | 516.7 | $464.3_{a}$ | 32.7 | 30.5 | 143.1 | 167.0 |
| NS | 581.6 | $620.9_{b}$ | 32.9 | 32.4 | 131.1 | 175.9 |

[A] Harvest weight was fitted as covariate.

Means without a common subscript are significantly different ($p<0.05$).

**Table 3. Sensory attributes least squares means for strains**

| Strain | Aroma | | Colour | | Sweetness | | Juiciness | | Biting | | Chewing | | Acceptability | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1 | T2 | T1 | T2 | T1 | T2 | T1 | T2 | T1 | T2 | T1 | T2 | T1 | T2 |
| G | 9.9 | $3.7_{bc}$ | $5.9_{bc}$ | 2.5 | 9.5 | 2.9 | 8.6 | $2.5_{b}$ | $8.3_{bc}$ | $2.4_{b}$ | 9.0 | $3.6_{b}$ | $10.2_{b}$ | 3.8 |
| E | 8.2 | $2.9_{a}$ | $9.1_{a}$ | 2.6 | 10.3 | 3.5 | 9.8 | $3.6_{a}$ | $10.4_{a}$ | $3.3_{a}$ | 8.7 | $2.8_{a}$ | $10.9_{ab}$ | 4.1 |
| M | 9.6 | $3.3_{ac}$ | $7.9_{ac}$ | 3.0 | 8.8 | 3.5 | 7.5 | $3.2_{a}$ | $6.5_{b}$ | $3.2_{a}$ | 10.0 | $2.7_{a}$ | $10.1_{ab}$ | 4.1 |
| NS | 8.6 | $2.9_{a}$ | $9.1_{a}$ | 2.4 | 10.5 | 3.7 | 9.7 | $3.5_{a}$ | $9.4_{ac}$ | $3.4_{a}$ | 9.2 | $2.6_{a}$ | $11.7_{a}$ | 4.0 |

T1 = Trial 1, range 0 to 15; T2 = Trial 2, range 1 to 5.
For each trait, means without a common subscript are significantly different ($p<0.05$).

In the case of strain we comment the results in more detail since this effect is the main focus of the paper. Also, we primarily focus on the GIFT strain relative to the others, consistent with the interest in assessing it relative to the predominant strain in Malaysia. Note also that there is no published information ascertaining which score is optimum for any of the traits. There were significant differences between GIFT and two of the other strains in aroma in trial 2 but not in trial 1. In both trials GIFT was rated as exhibiting greater intensity for the trait. In the case of colour there were significant differences in trial 1 but not in trial 2. GIFT was assigned a lower score for colour, reflecting the ability of the panelists to recognize it as distinct in this respect from the other strains. There were no significant differences among strains in sweetness. There were no significant differences in juiciness in trial 1 but there were in trial 2, where GIFT had the lowest intensity. For biting there were significant differences among strains in both trials, with GIFT exhibiting the second lowest and lowest intensity in trials 1 and 2, respectively. Strain differences in chewing were not significant in trial 1 but GIFT had a significantly greater intensity than the other strains for this trait in trial 2. In terms of general acceptability, in trial 1 GIFT had a significantly lower acceptability than the NS strain only, whereas the differences among strains were not statistically significant in trial 2.

The limitations of the design of a strain comparison such as this one have to be acknowledged (James 1975) and the results have to be cautiously interpreted. The observed differences in harvest weight, fillet yield and weight among the strains were small and most often statistically non significant. For harvest weight this result contrasts with most reports in which GIFT has had a clear advantage, suggesting that perhaps some Red Tilapia populations have also made progress in that trait. However, due to the relatively small number of fish involved this is something to be confirmed in larger scale trials, or by the judicious analysis of information from several small ones. The QDA is a technique generally recommended for product evaluation. However, it does not seem to lend itself to work with large numbers of fish. Its application entails training individuals so that they can identify and quantify the sensory properties of a product or ingredient, and this constituted a laborious and costly exercise. The training required the use of fish of the same strains to be later evaluated. The evaluation was time consuming due to its peculiarities and to the number of assessors in the panel that limited the throughput of fish. Hence, we decided to try a slightly simplified method of assessment (trial 2). The results obtained in trials 1 and 2 were not entirely consistent with each other. This is most likely due to the lack of a sharp distinction among the strains for flesh quality. Very importantly, even when differences were significant there were no extreme values, always falling for all traits within a range corresponding to acceptable flesh.

## CONCLUSION

Although, the main focus of selection in GIFT has been growth rate, the present study indicates that the selection emphasis placed upon that trait has not resulted in lower flesh quality, quite the opposite, it was very close or equal to the much favored Red Tilapia.

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