CHAPTER 3

COMPARISON OF FILLET YIELD AND GONADOSOMATIC INDEX (GSI) BETWEEN ALL-FEMALE AND MIXED SEX YELLOW PERCH (*Perca flavescens*) STOCKS.

INTRODUCTION

Sound marketing data is critical for business planning, capital acquisition, and the ultimate success of potential aquaculture ventures. The yellow perch market demands a skin-on butterfly fillet (Mike Libbin, Paragon Processing, Inc.; Chris Bennett, Bennett Fish, Inc., personal communications). In a 1996/97 survey, the vast majority (95%) of restaurant managers indicated that fillets were the preferred product form for yellow perch. Less processed products available include whole fresh (in the round) or whole frozen perch (Riepe, 1998). Yellow perch fillets are low in fat (0.8%) and phospolipids (Kinsella et al., 1977). These attributes result in yellow perch having a long shelf life, resistance to freezer damage, and minimal problems with off-flavor and cooking (Malison, 1999b). Restaurants prefer fresh (44%) and frozen (51%) fillets about equally when price and supply are not an issue. When yellow perch is actually purchased, however, about two-thirds (65%) of the restaurants purchase frozen fillets (Riepe, 1998).

The processing of yellow perch is expensive compared to other fish species, with total processing costs averaging $0.50-1.00/lb ($1.10-2.20/kg) or more for fillets (Malison, 1999). The butterfly fillet is a relatively difficult cut and requires skilled processors (for technique see Virginia Seagrant, 1999). At the present time, machine filleting results in an unacceptable loss of yield. Because of their small size, most yellow perch are scaled by machine and filleted by hand (Malison, 1999).

Due to the consumer preference for filleted yellow perch, maximizing fillet yields is a high priority for both producers and processors of aquacultured yellow perch. Selection among and within breeds and breed crosses has been used to improve carcass traits of livestock (Johansson and Rendell, 1968), and similar approaches may be useful for improving fillet yield in yellow perch. The identification of techniques or stocks that result in increased fillet yield will add to the total production and profitability of the industry.

OBJECTIVES

The objectives of this study were to: (1) compare the fillet yield of market-sized yellow perch between all-female and mixed-sex fish stocks, (2) compare the gonadosomatic index (GSI) in individual fish between these stocks and assess its possible affect on fillet yield, and (3) compare fillet yield and GSI between male and female individuals within a mixed-sex fish stock and between female individuals by stock.

METHODS

Fish used in this study were reared in recirculating aquaculture systems at the Aquaculture Research Facility, Virginia Polytechnic Institute and State University, Blacksburg, VA. Two distinct stocks of yellow perch were utilized in this study. The all-female stock (S1) was originally derived from Lake Mendota, Wisconsin (Coolwater Farms, Cambridge, WI). The mixed-sex stock (S2) was originally derived from Lake Erie (BPM Inc., Leetonia, OH). Yellow perch were selected from harvest-sized fish at the end of a 292-day growth period. Prior to selection, fish from both stocks were sorted according to size. Fish with total weights of at least 115g were considered of harvestable size. The harvest-sized fish from each stock were transferred from grow-out tanks (S1 n = 2, S2 n = 5) used in the study into one tank for each stock. After the fish were sorted, they were held without food for 96 hours, and then transferred on ice to the processing facility.

Processing measurements were conducted at a facility experienced in processing 113,000 kg of yellow perch annually (Bennett Fish, Inc., Loraine, OH). All fish were scaled using a full scaling machine (Fishmore, Windsor, Canada). A skilled processor then filleted perch by hand. To eliminate differences in individual fillet efficiency and technique, the same person cut all of the fish used in this study.

Measurements on individual fish included total weight before scaling and weight of butterfly fillet, both measured to the nearest 0.1 g. Individual fillet yield (S1 n= 18, S2 n = 19) was calculated as the weight of fillet over the total weight of fish prior to scaling. The carcasses of the fish examined for individual fillet yield were retained for recovery of gonads. The gonads were later removed and weighed to the nearest 0.001g. This data was used to determine the sex ratio in the mixed-sex stock, and to calculate and compare the GSI: [(weight of gonads/ total weight of fish)*100] in both stocks. Total weight, fillet yield, and GSI were also compared between male and female individuals from S2, as well as between S1 and S2 females.

Six groups of 20 individuals each (n = 120 individuals per stock) were also examined for fillet yield. Group measurements taken included total combined weight of the 20 fish prior to scaling and the combined weight of the 20 butterfly fillets. Group fish and fillet weights were measured to the nearest 0.005 lb (2.27 g).

Student's T-test was used to compare individual total weight, fillet yield, and GSI between stocks, between sexes within S2, and between S1 and S2 females. Group fillet yield and average total weight by group were also compared using T-tests between stocks.

RESULTS

Group results by stock

Mean total weight in S2 (154.8g, SE=1.64) groups were significantly heavier than S1 (135.5g, SE=1.64) groups ($p < .01$). Fillet yield was significantly greater in S1 (47.2%, SE=0.25) groups compared to S2 (44.9%, SE=0.25) groups ($p <.01$).

Individual results by stock

Mean total weight in S2 (201.1g, SE= 11.3) individuals were significantly heavier than S1 (146.1g, SE= 11.7) individuals ($p < 0.05$). Mean fillet yield was significantly greater in S1 (47.6%, SE= 0.52) individuals compared to S2 (43.0%, SE=0.51) individuals ($p<.01$). Mean GSI in S1 (1.01%, SE=0.15) individuals was significantly higher than S2 (0.54%, SE=0.14) individuals.

Individual results by sex within a mixed sex stock

Examination of the gonads revealed that 14 of the 19 fish in S2 were female (73.7%), while only 5 of the individuals were male (26.3%). There were no significant differences between the mean weight of males (189.9g, SE=29.6) versus females (205.2g, SE=17.7). Mean GSI was significantly higher in females (0.70%, SE=0.10) when compared to males (0.08%, SE=0.17: $p < 0.05$). There was no significant difference between fillet yield by sex ($p > 0.1$).

Individual results between females by stock

Mean weight in female S2 individuals (205.2g, SE= 13.2, n=18) was significantly greater than female S1 individuals (146.1g, SE= 11.7, n=14) ($p < 0.05$). Fillet yield was significantly greater in S1 (47.6%, SE= 0.52) individuals compared to female individuals from the S2 stock (42.7%, SE=0.59) ($p<.01$). GSI in female individuals was not different between stocks ($p > 0.1$).

Effect of fish size on fillet yield

Within each stock fillet yield in yellow perch increased slightly with size (see Figure 3.1 & 3.2). Although this is not a strong relationship (r^2 = 0.45 in S1 individuals, r^2 = 0.28 in S2 groups), small increases in fillet yield may be achieved by rearing yellow perch to a larger size.

DISCUSSION

The reported range in fillet yields for wild and cultured perch is 34-48% (Malison, 1999b). The results of this study are similar to those found by Heidinger and Kays (1993), who reported an average fillet yield of 45% for farm-raised yellow perch. Cultured yellow perch yield 4-5% more in fillet percentage than wild caught perch (Calbert and Huh, 1976; Lesser and Viltrup, 1978; Heidinger and Kays, 1993). Yellow perch have relatively high fillet yields when compared to tilapia, 25.4% for fish averaging 585g, and channel catfish, 30.9% for fish averaging 610g (Clement et al., 1994). This is partially due to increased yields found in skin-on butterfly fillets. Processing percentage between skin-on and skin-off walleye fillets can differ by as much as 8.4% (Summerfelt et al., 1996).

Lindsay (1980) reported fillet yields ranging from 42.5-43.5% for aquacultured perch averaging 150g. Wild caught perch (175-200g) had similar yields. It was concluded that the similarity in yields between these wild and cultured fish was mainly due to the larger size of the wild fish, as fillet yield generally increased with fish size (Lindsay, 1980). Fillet yield increased with size in both palmetto bass and paradise bass (Bosworth et al., 1998), as did dressing yield in channel catfish (Lovell and Li, 1992). In walleye, processing percentage did not increase with fish weight (Summerfelt et al., 1996).

In the current study, fillet yield in yellow perch increased slightly with size (see Figure 3.1 & 3.2). Although this is not a strong relationship (r^2 = 0.45 in S1 individuals, r^2 = 0.28 in S2 groups), small increases in fillet yield may be achieved by rearing yellow perch to a larger size. Revenues generated from higher yields would have to out-weight the production costs of rearing fish to a larger size.

Surprisingly, individuals and groups from the S1 stock had significantly higher fillet yields despite having a significantly smaller mean weight and significantly larger GSI. Perch can sexually mature before they reach a harvestable size, and sexual maturation may significantly reduce their growth rate and fillet yield (Schott, 1980). Fully developed yellow perch ovaries may result in GSI values of up to 35% (Malison and Garcia-Abiado, 1996) resulting in 10-25% reduction in fillet yield (Malison, 1999). However, GSI values in this study were extremely low due to the constant photoperiod and temperature maintained throughout the experiment, and had minimal effect on fillet yield.

The difference in fillet yield demonstrated between these stocks may be a result of differences in strain of origin. Significant differences in percentage of fillet between different strains and crossbreds have been demonstrated in rainbow trout (Hörstgen-Schwark et al., 1986). Differences in carcass yield have also been identified among strains of Atlantic salmon (Gjerde and Gjedrem, 1984) and channel catfish (Smitherman et al., 1983), and fillet yield also may differ among geographic strains of yellow perch (Mike Libbin, Paragon Processing, Inc.; Chris Bennett, Bennett Fish, Inc., personal communications). When compared to purebred walleye, processing yield was not improved in hybrid walleye (Summerfelt et al., 1996).

The strength of comparisons between male and female individuals within the S2 stock was hampered by the unequal sex ratio (73.7% female). These results are similar to those obtained by Melard et al. (1996) who found that 80% of the harvestable fish were female after one year in intensive culture conditions. Even though GSI was significantly higher in female individuals, the gonads in both sexes accounted for less than 1% of the total body weight and minimized the effect of sex on fillet percentage. Sexual maturation is inhibited in female perch under constant culture conditions above 18^{o}C (Melard et al., 1996) and this investigation indicates that it may have the same effect in male yellow perch. Processing percentages for skinless fillets between male and female walleye raised under intensive conditions were not significantly different (Summerfelt et al., 1996). Other research has shown that dress percentage in rainbow trout and gutted body weight in Atlantic salmon are both significantly influenced by sex (Gjerde and Gjedrem, 1984).

To eliminate the possible effect of sex on fillet yield, only female individuals were compared between stocks. Despite the fact that S2 individuals were significantly heavier, mean GSI values were similar between individuals of both stocks. Again S1 individuals exhibited superior fillet percentages and emphasizes the possible affect that strain may have on fillet yield in yellow perch.

Given the high value of yellow perch, even small increases in fillet yield would result in substantial increases in income for producers and processors. The results of this study indicate that selecting superior strains of yellow perch may increase fillet yields by as much as 4.6%. Using an average price of fresh fillets of $7.45 per pound (Riepe, 1998), understanding strain-specific yields can produce and additional income of $34,270 per 100,000 pounds of rounds produced. Conversely, a 10% reduction in fillet percentage has been shown to raise production costs by more than 5% in Argentinian hake (Crupkin et al., 1996).

SUMMARY

This study shows that exposing yellow perch to constant photoperiod and temperature conditions minimizes gonadal development. GSI values in this study were extremely low and had minimal effect on fillet yield. This results in high fillet percentages averaging 44.9-47.2%. Selecting superior strains of yellow perch may increase fillet yields by as much as 4.6%. The identification of superior yellow perch strains or strain crosses with regard to fillet percentage is of considerable importance to the industry. Harvesting yellow perch at larger sizes also appears to slightly increase yields regardless of strain.

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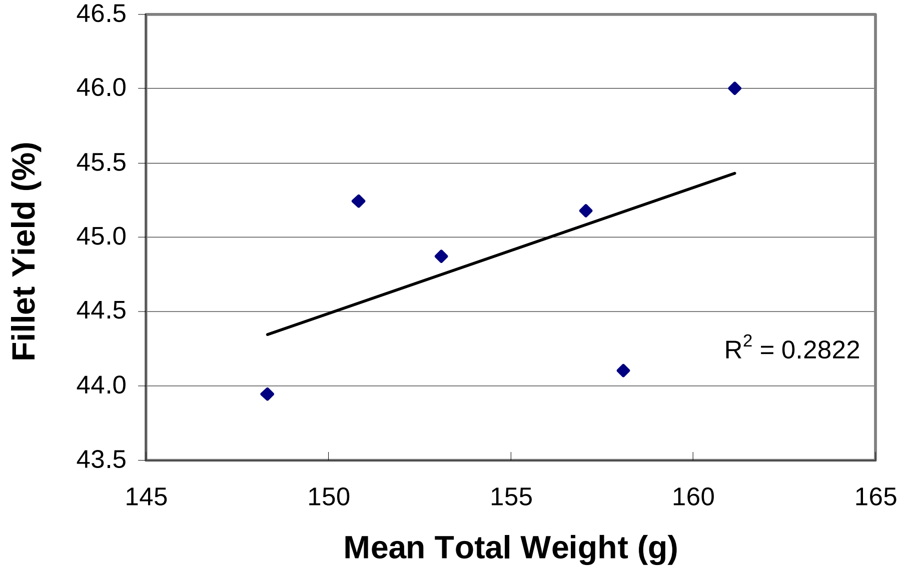

Figure 3.1. Mean total weight versus fillet yield in mixed-sex groups.

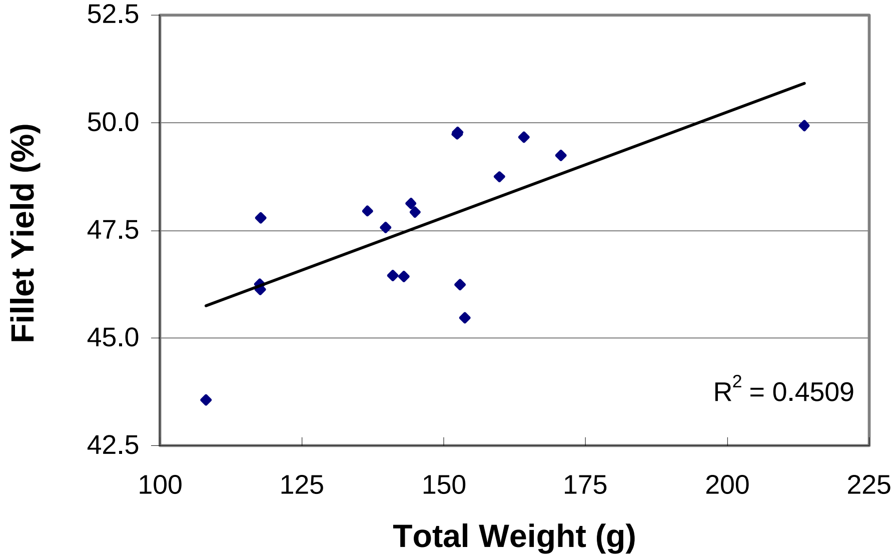

Figure 3.2. Total weight versus fillet yield in all-female individuals.