FORMULATED GEL-DIET VS. MINNOW DIET IN WALLEYE, *SANDER VITREUS,* FINGERLINGS

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ABSTRACT

Due to many difficulties in the production of Walleye (*Sander vitreus)* along with the high cost and process involved in acquiring pinhead sized fathead minnows *(Pimephales promelas)*, a formulated gel-diet, Mazuri Aquatic Gel-Diet, was investigated for its effectiveness in the culturing of walleye. The ability of walleye fingerlings to transition onto the formulated gel-diet effectively was observed on a daily basis for the length of a 32 day study. As well as observation, data analysis was conducted in a feed comparison of the unreleased gel-diet and a typical pinhead minnow diet based on Day 1 and Day 32 comparisons in length and weight. Walleye were observed to feed on the gel-diet throughout the study. However, the feed comparison results were not significant, ANOVA analysis; therefore, it could not be determined that the gel-diet or the minnow fed walleye grew more or less efficiently. This study opens up possibilities for the usage of a gel-diet on walleye fry to save production cost and avoid the difficulties of the pinhead minnow process. Future studies will be necessary to show the complete effectiveness of a gel-diet compared to a minnow fed diet of walleye in terms of growth.

Current walleye, *Sander vitreus,* production demand is for a larger sized fish for stocking to increase survival, as well as the demand for walleye as an important food fish. Walleye are typically pond reared on plankton (Johnson and Esser, 2009), and fed with various sizes of Fathead Minnows (*Pimephales promelas*), pinhead, crappie and fathead sizes, corresponding with walleye fingerling size, for grow out. However, the cost of minnows is expensive, $20 per kilogram (Fischer, 2009), so a more cost effective way to rear Walleye should be investigated. Availability or timing of when you get the shipment of minnows is also an issue (Fischer, 2009). Timing of adding minnows can be critical in production, but a gel diet can provide a way to avoid the use of minnows. Also, biosecurity and fish health have created interest in moving away from the conventional minnow feeding to keep facilities disease free. Testing of all minnow shipments brought into a facility also brings the cost up, and the risk of bringing a disease in can threaten your productivity. To raise extended growth, larger, walleye cost effectively and avoid fish health threats, formulated feed may serve as an alternative for raising walleye.

Traditionally walleye have been a difficult fish to intensively culture due to their inability to accept commercial formulated feed easily. Poor feed acceptance, poor survival and cannibalism are issues in the attempt to feed train walleye (Johnson and Esser, 2009). Walleye have a low tolerance of the conditions in which they are cultured. Difficulties with the intensive culture of walleye have lead to a feed company producing a specific diet called Mazuri Aquatic Gel-Diet, which may be utilized as a replacement for minnow feeding. The belief is that this gel-diet can be mixed with similar moisture content to that of a minnow making it more attractive to Walleye, while still providing the nutrients needed for the fry to grow as well or better than they would on a minnow diet (Appendix A). This diet may be less expensive, $19.36 per kilogram (Fischer, 2009), for the dry mix, so for a kilogram of 60% moisture mixed diet, the cost would be $11.62. The diet would also contribute to biosecurity and give

more control over daily feeding than a minnow diet. The amount of diet fed and time of each feeding can be closely monitored and controlled, compared to the one time addition of minnows into a pond, making it a more reasonable approach to culturing walleye.

This proof of concept study will be a comparative study between the Mazuri Aquatic Gel-Diet and pinhead sized fathead minnows. The feed comparison will examine the effectiveness in training the fish to feed on the gel as well as growth on each diet. Specific Growth Rates (SGR) of average length and weight from the beginning of the study will be compared to those at the end of the 32 day study for each of the different feeding regimens. These observations and data will provide a view of whether or not the new diet could be effective in the culture of walleye.

Methods

The study was conducted in the main, 7,085m^2, Aquatic Barn at the University of Wisconsin Stevens Point (UWSP) Northern Aquaculture Demonstration Facility (NADF) located near Bayfield, Wisconsin, USA.

Tank Info

Six circular 218L (0.22m^3) fiberglass, indoor tanks, located in an experimental dark room in low light conditions (100 lumens, 100 watt floodlight on a reel stat), with heated, degassed flow-through groundwater were utilized for the study. Water flowed into the tank through a 1/2" PVC pipe at a flow of 2.1L/minute. Water flowed out through a 1" PVC stand pipe in the center of the tank which is protected by a surrounding plastic, 1/8" mesh screen. The sides of each tank were painted black, and the bottoms of each tank were painted gray to assist in providing low light conditions and reduce reflection in the tanks. Lighting was provided by 100 lumens, 100 watt flood lights on a reel stat.

Tank Cleansing

Water temperature (°C), pH and oxygen (mg/l) was monitored and recorded weekly using a handheld portable YSI oxygen meter (Model 550 A, YSI, Inc.). Water was kept at an average of 19.8 °C, oxygen concentration of 9.5 mg/l and at a pH of 8.4. Tanks were kept cleaned every 3 days. The sides and bottoms were cleaned with a household paintbrush. Excess feed, feces, and particles that settled to the bottom were removed utilizing a siphon hose. The stand pipe was removed to flush out any remaining feed or feces not removed by siphon. The mesh screen surrounding the stand pipe was removed and rinsed with a stream of fresh water from a garden hose and replaced.

Gel-diet Preparation

Mazuri Aquatic Gel-Diet Powder was mixed with 60% moisture mix (60mL of boiling water and 40 grams of the powder). Powder was mixed, refrigerated and allowed to settle into a mold. New batches were prepared weekly and kept refrigerated to ensure freshness and quality. This prepared gel-diet was cut into pieces similar to the size of the pinhead minnows (12" to 25mm) with the use of a household cheese grader. As the fish grew, larger leech-like pieces (25mm to 50mm) were created (Day 14), utilizing a different section of the cheese grader which created leech like portions of the diet.

Study Protocol

15 feed trained Walleye fingerlings, Mississippi River strain, spawned in March at NADF and raised following the rearing protocol developed by Iowa Department of Natural Resources (Johnson, 2009), had an average size of 71.80 mm long and weighing 4.94 grams were placed into each of the six experimental tanks. Before the study began each tank was given minnows for a time period of 2 days to acclimate each tank to feeding on pinhead size fathead minnows as typical in normal pond rearing. Any

mortalities occurring in the 2 day acclimation period were removed, recorded and replaced with a fish of similar size. Lengths and weights of each fish were taken to determine starting total body weight. Tank total fish weight was equalized within 5% error, among treatments. After the acclimation period, the lengths and weights were recorded for comparison to the final measurements at the end of the 32 day study.

Initially 3 tanks received 15 pinhead sized fathead minnows weighing 2.5 grams, and 3 tanks received 2.5 grams of the gel-diet daily. The minnows were fed to the fish once daily in the morning, 8am, and the gel-diet was fed 4 times daily at 8am, 10am, 12pm, and 2pm daily. After 15 days, as fish size increased, the feed amounts were increased to 3.7 grams of minnows and 3.7 grams of gel-diet daily, which was equal to 5% of the initial total body weight of the fish. Feeding behavior and any mortality was observed and recorded daily. Fish survival, reaction to each diet, and the condition factors of the fish on the various diets were observed and recorded for analysis. A final count of all fish as well as their lengths and weights were taken on the final day of the study, Day 32.

Results

Following the 32 day study, fish were measured and counted showing a loss of fish throughout the 32 day study.

Table 1: Fish count totals Day 1, Mortality total throughout the study, and Day 32.

Fish Totals	Day 1	Mortality	Day 32
Minnow Fed	45	3	42
Gel Diet	45	2	40

The results of the minnow fed and the gel-diet fed fish were compared using both average length and weight of the walleye, Figs. 1 and 2. In order to pool these data as one group, a statistical analysis, ANOVA, was conducted for the minnow diet and gel-diet tanks. In each case the 3 separate tanks for

each diet showed no significant difference between the tanks, $p > 0.05$, in weight or length. This result allowed for the pooling of each complete set of minnow fed and gel-diet fed walleye as a data set of 45 fish each. With the data sets pooled t-tests were ran for both weight and length at Day 1 and Day 32. All data was found to be not significantly different, Table 2, allowing for comparison of the pooled data.

Table 2: T-test results for Weight and Length for Days 1 and 32

T-test	Day 1 Weight	Day 1 Length	Day 32 Weight	Day 32 Length
p-value	>0.05	>0.05	>0.05	>0.05
t	0.2023	0.1267	0.8344	1.273
df	88	88	80	80

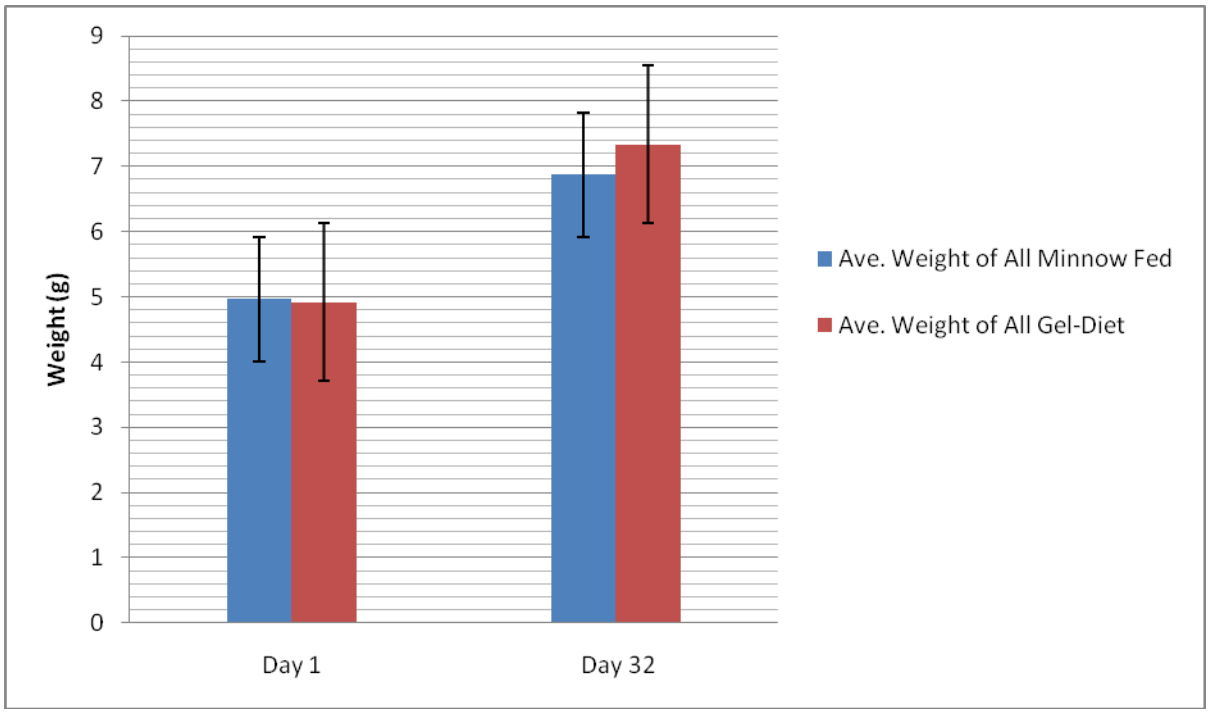

Figure 1: A comparison of the average weight (g) in the minnow fed fish to the average weight of gel-diet fed fish at Day 1 and Day 32.

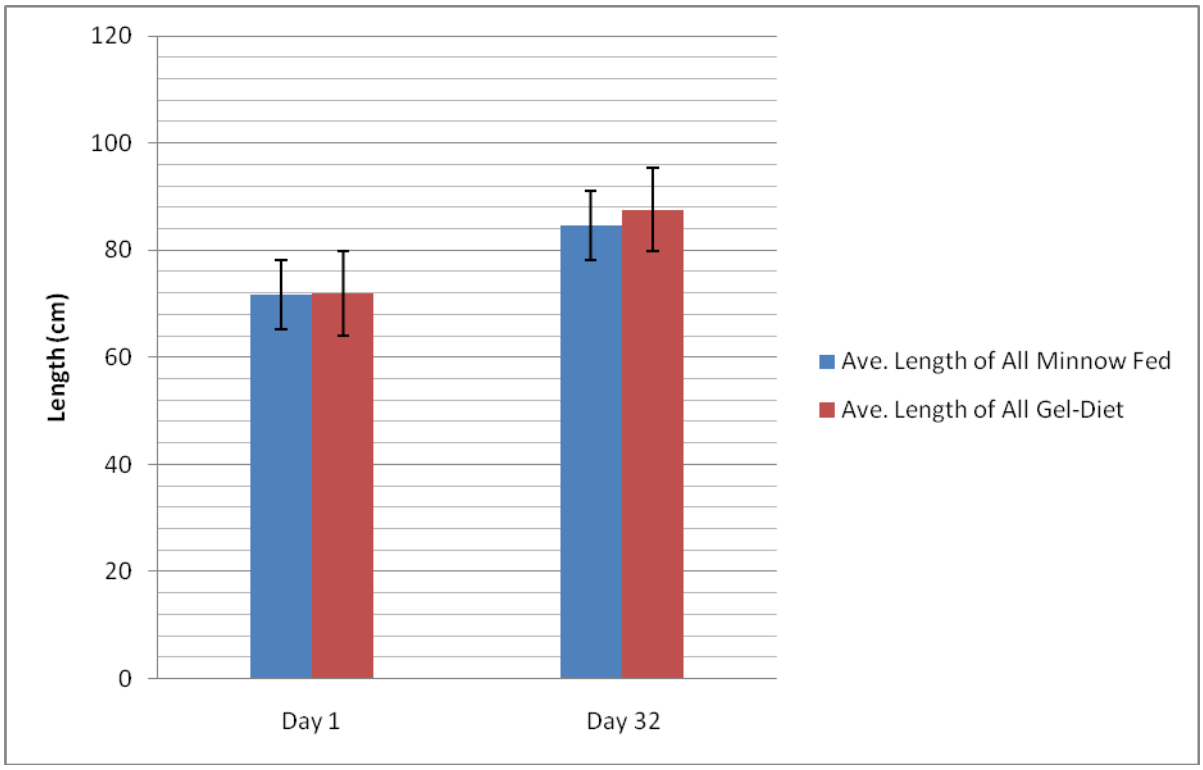

Figure 2: A comparison of the average length (cm) in the minnow fed fish to the average length of gel-diet fed fish at Day 1 and Day 32.

Table 3: Specific Growth Rate (SGR) in percentage per day of minnow fed and gel-diet walleye for both weight and length.

SGR=(ln(final weight)-ln(initial weight)/Total Days)*100

Specific Growth Rate (SGR) % per day		
	Weight	Length
Minnow Fed	0.79	0.51
Gel-Diet	0.86	0.62

Discussion

From data and analysis a slightly higher growth was observed in the gel-diet fish. In each case of average weight and average length of the two groupings of walleye, minnow fed and gel-diet, the gel-diet had a slightly higher ending point at Day 32, Figs. 1 and 2. This data was not found to be significant due to the overlap of the error bars between minnow fed and gel-diet feeding techniques, Figs. 1 and 2. The difference in average weights and length may have been skewed, as there were less walleye accounted for in the gel-diet tanks, Table 1, since the project started with 45 fish and finished with 40 total fish having 2, not the difference of 5, mortalities occurring throughout the study. Walleye, 3 individuals, were not accounted for in the gel-diet fish, showing cannibalism in the gel-diet fed walleye. Specific Growth Rate in percentage per day is also higher for the gel-diet fed walleye, Table 3, giving us a belief that the gel-diet walleye grew more efficiently. As previously stated, this result may be biased due to the absence of the cannibalized walleye.

Whether or not there was significance in the growth of the walleye in the separate feeding methods, there was a great deal of observation that added to the proof of concept portion of this study. Observation of gel-diet feeding took place and the walleye did consume the feed throughout the duration of the study. This was increasingly apparent when the gel was formed into larger, leech-like, portions. The leech-like portions seemed to float or flutter through the water creating a more attractive piece of feed for the walleye fingerlings to consume. Compared to the minnow feeding event, the gel-diet walleye were not quite as aggressive in attacking the feed, but in both cases, as human presence became apparent, the fish came up to the surface waiting for the addition of feed to be made to the tank. The lack of aggressiveness in appearance may be attributed to the fact that the gel-diet is not trying to actively escape the predator walleye.

A cause for concern in this particular study was the possibility of cannibalism in one tank of the gel-diet fed walleye. Cannibalism has been known to be a cause for concern in walleye fry and fingerlings (Fischer, 2009). In this case we have a possibility that a single fish which may not have taken to the diet was cannibalistic in that certain tank. This situation would need to be observed more carefully in order to determine whether it was relevant that it was in a gel-diet fed situation, since walleye have been observed to be cannibalistic in other situations.

Conclusion

Although there was not any significance in the growth for the first trial of this newly tested gel-diet fed walleye, the option of this diet should not be disregarded as an alternative to minnow feeding. The walleye were observed to effectively feed on the diet throughout the course of the study meaning the possibility of success for the gel-diet. This feeding method provides a cheaper option than the pinhead minnows, saving money and making it possible to result in a higher profit. The diet also gives more control over the production raising the interest in a potential future use of this method. More research needs to be conducted to validate this diet as being completely successful for walleye fingerlings, but in this occasion it appears that the walleye fed successfully on the diet leaving the option for future investigation. It would be interesting to see this study done again over a longer period of time or possibly on a larger scale with more fish to validate the diet's effectiveness as well as the max potential it can sustain.

Literature Cited

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