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The Evolution of Body Muscle Composition of the African Catfish *(Clarias gariepinus)* (Burchell 1822)

Jacob Maithya

Abstract

Changes in body muscle composition of *Clarias gariepinus* were studied in fish reared from 1.08 g to 383 g mean body weight in a 201-day culture period. Changes in the amount of protein content, dry matter and ash-free dry matter in the muscle tissue can be described as a function of body weight. The percentage of protein content was observed to be higher in bigger fish. Fat content was low throughout the fingerling stage. Specific growth rate decreased significantly at 400 g mean body weight ($P<0.05$) while feed conversion rate increased. The conclusion, based on the culture conditions in this study, is that the optimal weight for harvesting *C. gariepinus* is 400 g.

Introduction

The culture of the African catfish *(Clarias gariepinus)* has become popular among African fish culturists. The growing interest in *Clarias* culture has been associated with its size, fast growth, omnivorous feeding habits and resistance to extreme environmental conditions. The relatively simple techniques for artificial reproduction, coupled with its widespread availability all over Africa, greatly favor the culture of this species (Ozouf-Costaz et al. 1990). *Clarias* culture in Kenya is presently concentrated in the western region and has almost replaced tilapia culture.

To reduce production costs, the ideal harvesting stage must be known to the farmer. This experiment was designed to assess the changes in the composition of muscle tissue of *C. gariepinus* with reference to fat and protein buildup during its growth.

Materials and Methods

One hundred artificially produced *C. gariepinus* (mean weight 1.08 ± 0.61 g) were randomly selected and used in the experiment. Fish were stocked in two replicate 60 liter culture tanks and reared for 201 days in a flow-through system.

The fish were fed two times daily on an optimal commercial trout diet recommended by Hogendoorn et al. (1983), as the most efficient feed conversion was observed in *C. gariepinus* fed with this diet. Twenty fish from each tank were randomly sampled biweekly for weight and length measurements. At least 5 fish from each tank were killed, filleted and preserved at 20°C for fat, protein, moisture, dry weight (DW) and ash-free dry weight (AFDW) analysis. Crude protein was determined using the Kjeldahl N x 6.25 technique. Crude fat analysis was done using acid hydrolysis followed by fat extraction. Dry weight was obtained by drying muscle samples at 100°C in an oven for a minimum of 16 hours (until constant weight was obtained). Ashing was done overnight at 550°C in a thermoactive muffle furnace.

Results

Within 201 days of tank culture, the *C. gariepinus* exhibited the following allometric growth model:

$$W = 0.01\ L^{2.84}$$

where

W = Weight (g)
L = Length (cm)

The condition factor fluctuated between 0.93 and 0.70 through the entire culture period. Final mean weight recorded on day 201 was 383.15 g with a mean length of 37.96 cm. The maximum weight recorded on day 201 was 894.79 g for a fish measuring 50.5 cm.

Body size variation was significant, a characteristic of this fish species that has been observed by Hecht and Appelbaum (1987). Trends in feed conversion rate and specific growth rate for the entire culture period are shown in Fig. 1. The relationship is characteristic of a normal population of the species.

Moisture content was observed to be high during the early stages of growth and then decreased with increasing body size. The relationship between the proximate body muscle composition and the body weight in *C. gariepinus* juveniles during the experiment are shown in Tables 1 and 2. These results are based on the correlation of muscle tissue component value with the weight of the corresponding individual. Protein and fat content and their relationship to weight are illustrated in Figs. 2, 3 and 4. Protein content in *C. gariepinus* increased curvilinearly (Fig. 2) while the fat content did not change significantly with increasing body weight (Fig. 3).

***Table 1. Correlation of different body muscle components (%) with the body weight (g) of juvenile* C. gariepinus.**

Body muscle component	Correlation with body	Significance level weight of fish
Fat	Negative	$P < 0.05$
Protein	Positive	$P \leq 0.01$
Moisture	Negative	$P < 0.01$
Ash	Negative	$P \geq 0.01$
DW	Positive	$P < 0.01$
AFDW	Positive	$P \leq 0.01$

Table 2. The observed linear relationship between different body muscle components and body weight of* C. gariepinus: *regression of individual component values (%) on Log of mean body weights of juveniles.

Mean % component	Relationship with body weight	
Fat	No relationship	
Protein	MP = 13.59 + 2.35 Log MBW	r = 0.93
Moisture	No relationship	
Ash	No relationship	
DW	MA = 2.79 - 0.70 Log MBW	r = 0.70
AFDW	MAF = 18.63 + 0.96 Log MBW	r = 0.52

MBW = Mean body weight (g)
MP = % mean protein in body muscle
MA = % mean ash in body muscle
MAF = % mean ash-free dry weight (AFDW) in body muscle

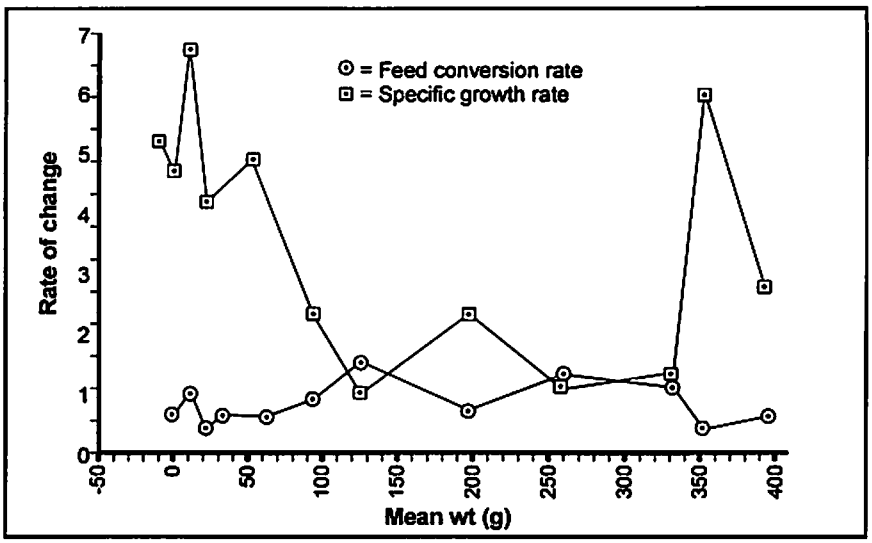

Fig. 1. Feed conversion rate and specific growth rate of* C. gariepinus *reared for 201 days.

Discussion and Conclusions

Under culture conditions, *C. gariepinus* have been reared to 765 g in 6 months (Christensen 1981). In this experiment, the greater part of the population weighed over 300 g after 5 months. Values of over 700 g body weight were recorded in some cases. The experiment can be useful for the purposes of predicting growth patterns during commercial rearing of this species. It can be used to estimate the changes in composition of body muscle tissue during the development stages of *C. gariepinus* and relate them to mean weight and age. As the juveniles were fed solely on a commercial dry feed, the conclusions of this experiment are only applicable to cases where live feed is not used.

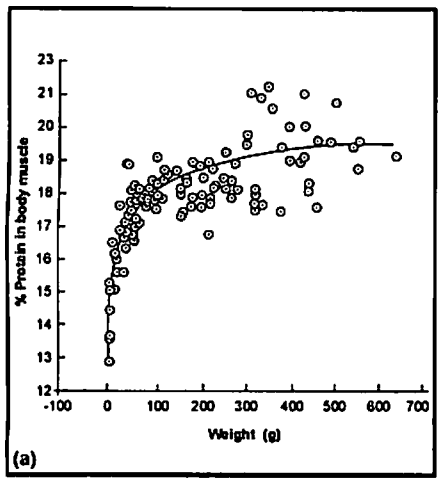

Fig. 2. Evolution of percentage protein content in body muscle with fish growth.

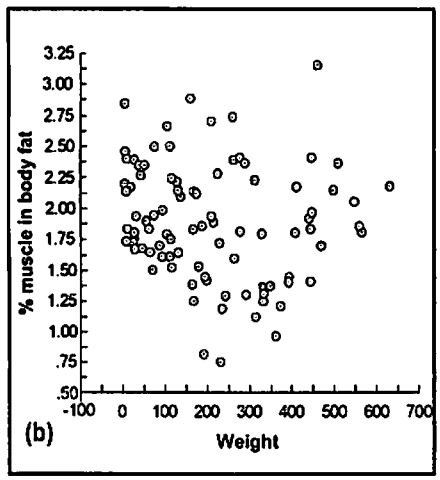

Fig. 3. Evolution of percentage fat content in body muscle with fish growth.

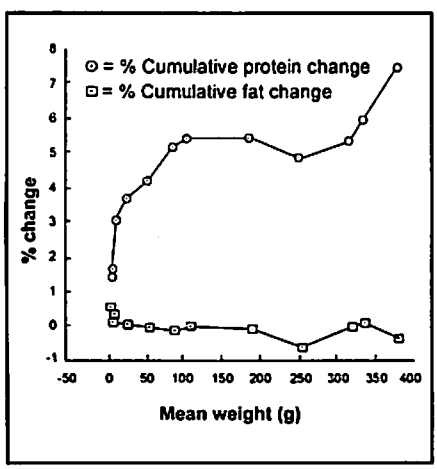

Fig. 4. Cumulative percentage change in protein and fat contents in body muscles of C. gariepinus *reared for 201 days.*

Fat content in *C. gariepinus* body muscle is independent of changes in body weight of the fish and may be associated with higher feeding levels (Hogendoorn et al. 1983).

Total protein buildup in the muscle tissue of this species increases with and has a direct correlation with body weight. The same results were obtained by Reis et al. (1989) while working on protein-energy ratios in channel catfish *(Ictalurus punctatus)*. If the initial body weight and weight gain are known, increase in protein content can be estimated from the relationship established between body weight and protein content. The following results obtained from this experiment are useful for making such estimates.

1. $P = 13.80\ BW^{0.058}$
2. $A = 2.95\ BW^{0.19}$
3. MP = 13.59 + 2.35 Log MBW, r = 0.93
4. MAF = 18.63 + 0.96 Log MBW, r = 0.52
5. MA = 2.79 - 0.70 Log MBW, r = 0.70

Where;

BW = live body weight gain (g)
P = % protein gain in muscle
A = % ash gain in muscle
MBW = mean body weight (g)
MP = % mean protein in muscle
MAF = % mean ash free dry weight (AFDW) in muscle
MA = % mean ash in muscle

From ±400 g live body weight up, specific growth rate decreased significantly ($P<0.05$) but the feed conversion rate increased substantially ($P<0.01$) - a trend which can be associated with insignificant protein gain. It can be recommended, therefore, that under similar culture conditions, 400 g is a suitable weight for harvesting *C. gariepinus* for animal protein.

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