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# Carcass Characteristics of Farmed Medium Carp *Hypselobarbus pulchellus* (Day, 1878)

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## Abstract

The carcass quality traits of an endemic carp, *Hypselobarbus pulchellus,* were assessed to determine its flesh yield and quality. Fish were stocked at 5000 no. $ha^{-1}$ in 0.1 ha earthen composite aquaculture ponds with a mean temperature of 24.6°C and given supplementary feed once daily. Fish weighing between 1.8-2.5 kg were assessed for carcass and offal yields as well as carcass cutability, organoleptic evaluation and proximate composition. Dressed fish (n=10) were cut at three median places to yield head, first, second and third body sections. The fish had a length of 48.2±6.4 cm and weight of 2.1±0.71 kg with a condition factor (K) of 3.5±0.7. The second body section (BS) of the fish had the maximum girth, area and weight followed by first and third body sections. The girth, area and weight of the three BS were linearly proportional to the weight of the fish but not to its length. The variations in the characteristics were also higher in the bigger sections. The three body sections constituted 64% of the weight of fish, while the offal and head comprised 26 and 10% respectively. Mean yield on dressing of fish was 70% with a meat: bone ratio of 3.27. There were no differences between the first, second and third body sections in their proximate composition. Brine cooked sections evaluated by a panel were not significantly different in taste. The fish had a proximate composition of 73.2±0.7% moisture, 23±0.6% protein, 5.3±1.6% fat and 1.4±0.2% ash.

**Keywords**: Carcass, characteristics, analysis, *Hypselobarbus pulchellus*, composition

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## Introduction

*Hypselobarbus pulchellus* (Day 1870) locally known as '*Haragimeenu*' is an important endemic fish of the Krishna River basin that is highly sought after for its tasty flesh and efforts are being made to raise the fish through aquaculture. Due to its herbivore and grass diet, it has been touted as an indigenous alternative to grass carp in aquaculture (David & Rahman, 1975). However, the acceptance of a fish by the aquaculture farmer depends not only on its quick growth but also on its flesh yield and quality, the latter being denoted by the carcass quality characters. Carcass quality characteristics have been used for diverse purposes in aquaculture such as assessing the effects of starvation in common carp (Assareh et al., 2013); for predicting the processing yields in rainbow trout selective breeding programs (Haffray et al., 2013), to assess the influence of dietary protein/energy ratio in Eurasian perch (Mathis et al., 2003), to evaluate performance of pike perch reared in recirculatory systems at suboptimal temperatures (Zakes et al., 2013) and to differentiate between populations of coho salmon (Neira et al., 2004). Flesh quality traits have been extensively used in salmonid breeding for quality improvement (Gjedrem, 1997), but such efforts have been few in other fish (Nguyen et al., 2010 a;b). Differences have been observed in carcass quality of common carp grown on different feeds (Oberle et al., 1997). Carcass quality of farmed mrigal and silver carp have been compared (Sahu et al., 2014a), while carcass characteristics of catla, rohu and hilsa have been studied as a function of their size (Sahu et al., 2013a;b; 2014b). But there have been no reports on the carcass characteristics and meat quality of either wild or aquaculture produced *H. pulchellus*. This paper attempts to address the gap and describe the carcass quality characteristics and proximate composition of formed *H. pulchellus* (Day 1870).

## Materials and Methods

*H. pulchellus* juvenills collected from the wild were stocked in two 0.1 ha (25x40 m) composite earthen culture ponds at 5000 no. $ha^{-1}$, and fed once daily with rice bran: peanut oil cake (1:1) mash diet. Culture conditions were, temperature: 24.6±3.5°C, pH: 7.5±1.1, dissolved Oxygen: 5.3±2.9 ppm and hardness: 203±54 ppm $CaCO_3$. Ten fish (48.2±6.4 cm, 2.1±0.7 kg; length range: 40-56 cm and 1.8-2.5 kg, n=10) were harvested from the two ponds by drag netting and brought to the laboratory within 30 min of capture. They were washed and subjected to carcass analysis as described elsewhere (Sahu et al., 2000) but without separation into sex or size classes. Lengths and total weight of fish were recorded to the nearest mm and g respectively and circumferences were measured. Each of the fins were removed separately and weighed to the nearest gram. Condition factor (K) was computed as; K= (Total weight/(standard length)$^3$) x 100. Next the fish was descaled and weight of scales recorded. Scales of *H. pulchellus* are rather large (~1.5 cm) and were sliced away with a knife from the sides and scraped off near the head and belly with little loss (< 0.5%). Gonads, gills and other organs were removed individually and weighed. Following gutting, the fish was cut in to 4 Body Sections (BS, See Fig. 1). Impression of the anterior part of each section was traced on paper, which was later cut and its area determined on a graph paper (Sahu et al., 2014a). Flesh from all sections except the head was extracted initially by filleting and later as much as possible by scraping. The fillet and meats from each section were pooled separately and analyzed by AOAC methods for moisture (#945.32), fat (#920.85), ash (#942.05) and protein (#920.87) (AOAC, 1980). Bite sized fillet pieces from each section were boiled in 2% brine for 5 min and evaluated by a 10 member panel on a modified 7 point Hedonic scale (Lawless & Heymann 1998) described as follows: Like extremely (7); Like moderately (6); Like slightly (5); Neither like nor dislike (4); Dislike slightly (3); Dislike moderately (2); Dislike extremely (1). Carcass analysis parameters were subjected to statistical analysis using Excel® software.

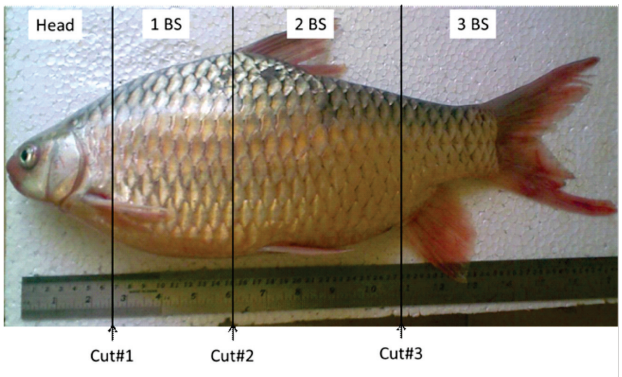


Fig. 1. Photograph of *Hypselobarbus pulchellus* (Day, 1870) showing the position of the three body cuts made and the resultant sections namely; Head, First body section (1 BS), Second body section (2 BS) and Third body section (3 BS)

## Results and Discussion

The morphometric data of the fish are presented in Table 1. The body circumferences at the three sections were proportional to the section areas in impression and highly significant when all sections were taken together ($R^2$=0.81), but the coefficients were low and not significant when separately analyzed for each BS ($R^2$=0.30 to 0.56, data not shown) (Fig. 2). Regression of the areas of three body sections on the total weight of the fish was highly significant when taken separately for 1$^{st}$ and 2$^{nd}$ BS, but regression of the 3$^{rd}$ BS area on weight of fish was not significant and decreased slightly with increase in weight of fish (Fig. 3). The

Table 1. Body morphometrics of sampled *Hypselobarbus pulchellus* (Means±SD, n=10). Harvested during summer 2014

| Traits | Value |
|---|---|
| Total weight, g | 2144±710 |
| Total length, cm | 48.2±6.4 |
| Standard length, cm | 39.2±5.5 |
| Fork length, cm | 42.4±6.3 |
| Body circumference or girth at cut 1§, cm | 28.2±2.8 |
| Body circumference or girth at cut 2§, cm | 37.6±5.7 |
| Body circumference or girth at cut 3§, cm | 25.9±2.7 |
| Body section 1 area* $cm^2$ | 52.5±9.2 |
| Body section 2 area* $cm^2$ | 67.3±13.6 |
| Body section 3 area* $cm^2$ | 38.8± 6.9 |
| Condition Factor, (K) | 3.5±0.7 |

§- Cut 1- Posterior to base of pectoral fin, Cut 2- Anterior to base of dorsal fin and Cut 3- Anterior to base of anal fin. *Area of sections measured by tracing outline of sections on graph paper. See Materials and methods and Fig.1 for details

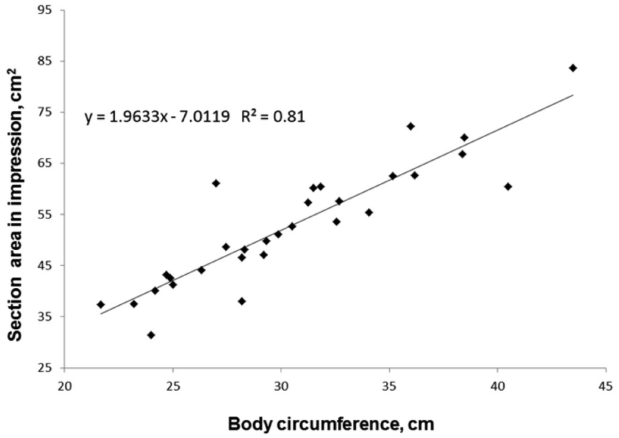


Fig. 2. Regression plot of the areas of the first, second and third bodysections on body circumference at respective cuts of the fish *Hypselobarbus pulchellus* harvested during summer 2014. (n=10)

regression of all the section areas together on weight of fish was also not proportional or significant. The mean condition factor for *H. pulchellus* (3.5) was much higher than observed for major carps like catla (1.4), mrigal (1.1) and silver carp (1.47) (Sahu et al., 2013b; 2014a) that were of comparable weight. Hilsa (2.59, Sahu et al., 2014b) and rohu (1.09, Sahu et al., 2013a) also had lower condition factors than *H. pulchellus,* but their body weights were lower. In a previous report of female *H. pulchellus* with gonado somatic indices (GSI) between 1.5 to 12.5, condition factors were more proportional to the weight of fish than to the GSI possibly due to the lower weight of the fish (1.16 kg) and season of harvest (July-August, 2006) employed in the study (Sridhar et al., 2014). Condition factor is known to increase with size and age in carps, due to increase in both bone and muscle tissues and is deemed to be particularly important for carcass and fillet yields (Fauconneau et al., 1995). It is also considered as a good indicator of 'well-being or fitness' of fish and assumes that heavier fish of a given length are in better condition (Bolger & Connolly, 1989), but could be caused by either genetic or environmental factors (Knaepkens et al., 2002).

Analysis of the three BS areas and weights revealed that, the second BS had the highest cross-sectional area as well as regression co-efficient on weight followed by first BS. The 3rd BS with the least area of the three also had a slightly negative slope of the regression (Fig. 3). The weights of head and dressed body were proportional to the total body weight as expected, but the latter increased more sharply than the former with the increase in body weight.The mean condition factor of the fish analyzed (3.53±0.69) was highly proportional to the weight of fish ($R^2$=0.91) but was poorly correlated with any of the length parameters ($R^2$=0.47-0.58). The mean weights of head, 1st, 2nd and 3rd body sections are shown in Fig. 4. Of the four,the 2nd BS was the biggest followed by 1st BS, head and 3rd BS. The variation in the weights of body sections was higher in the

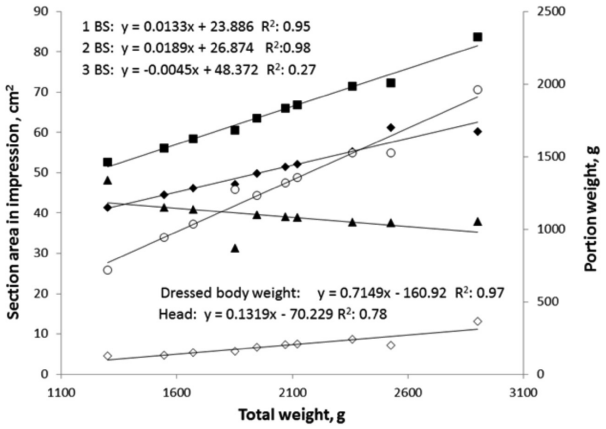


Fig. 3. Regression plot of the areas of the three body sections and weights of head and dressed body on the total weight of the fish *Hypselobarbus pulchellus* harvested during summer 2014. u- 1 BS (first body section), n-2BS (second body section), p-3 BS (third body section), Head and ™ - Dressed body weight. The regression equations of the body sections and parts on the total weight of fish are also shown on the graph. (n=10)

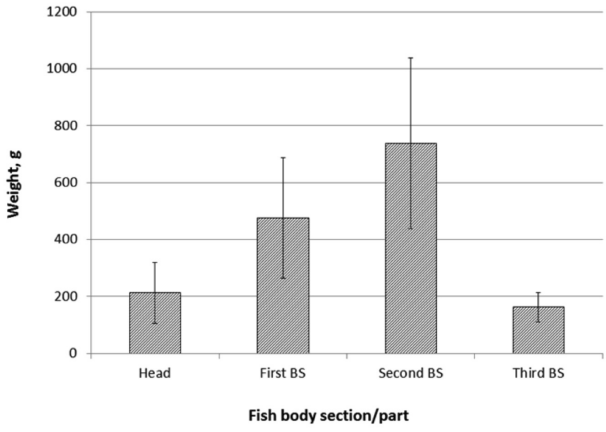


Fig. 4. Average weights of the first, second, third body sections (BS – Body section) and head of the fish *Hypselobarbus pulchellus* harvested during summer 2014. Error bars indicate respective standard deviations. (n=10)

bigger sections, decreasing as the body sections became smaller. The higher girth, section area and weight of the second BS followed by first and third body sections of *H. pulchellus* may be typical of other cyprinid fishes, but the variations in them were far greater than those observed previously for Indian major carps (Sahu et al., 2013a;b; 2014a). Further, the increase in size of *H. pulchellus* was found to be mostly reflected in the anterior parts (first and second body sections) of the fish; a trait that is desirable in view of the higher meat yield from these sections. This observation however, would need validation by a more extensive study with fish weights spread across a greater size range or size classes than attempted in this study.

The proportion of the main body parts in the total weight of fish was on the same lines as their individual weights. Non usable body parts (gut contents, scales and gills) formed a quarter of the fish (Fig. 5). The proportion of meat and bone in the major sections of the fish body (Fig. 6) revealed that the 2nd and 1st body sections had the most usable meat and the least bone, while head had more bone than meat and thus yielded lowest meat among all the body parts. The 3rd BS which was proportionately smaller than the head however had a higher proportion of meat than the latter. The average meat and bone contents of the fish were 1158±437 g and 352±130 g respectively with a meat:bone ratio of 3.27±0.28. Mean yield on dressing of pulchellus (gutting, heading and scaling) was 70%. Various

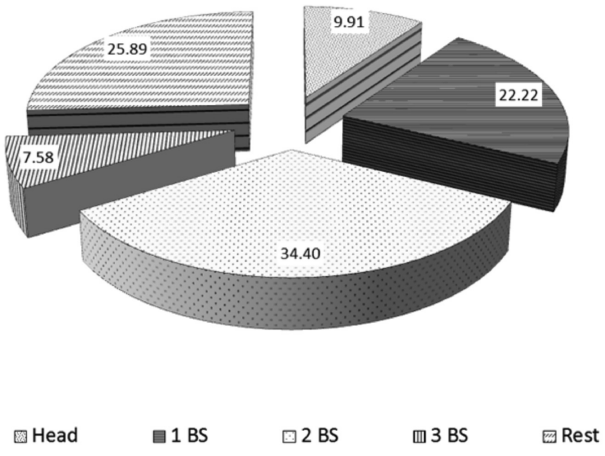


Fig. 5. The percentage proportion of body sectionsand parts of the fish *Hypselobarbus pulchellus* harvested during summer 2014 in the total weight of the fish. (n=10).1 BS (first body section), 2 BS (second body section), 3 BS (third body section)

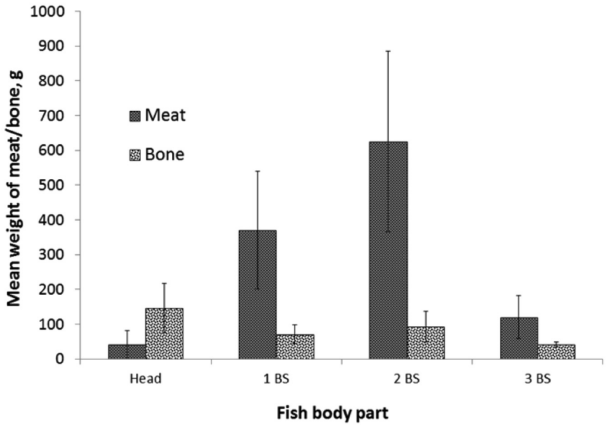


Fig. 6. Average meat and bone content of the major body sections and head of the fish *Hypselobarbus pulchellus* harvested during summer 2014. Error bars indicate standard deviations. (n=10)

species of commercially farmed silurids (catfishes) have been reported to yield between 52-70% on dressing (Fauconneau & Laroche, 1996), while the farmed European catfish (*Silurus glanis)* yielded 60.97% (Jankowska et al., 2007). Traditional feed diets of wheat, maize, rye or lupin seeds given to common carp did not result in differences between skinless fillet, viscera and residual carcass proportions, but fillet proportion was reduced when the sole feed was zooplankton (Oberle et al., 1997). Head size, which is well known to affect the dressed body weight is higher in catla (31.2%), rohu (19.4%) and silver carp (27.5%) than in pulchellus (9.9%), explaining their greater dressed body weight % (85.4, 83.3 and 92.8 respectively *vs.* 79%), but mrigal with a marginally greater head size (14.9%) hasa much higher dressed body weight (89.4%). This is perhaps attributable to the larger sizes of mrigal employed in these studies (Sahu et al., 2013a;b; 2014a).

The offal composition and dressed carcass traits of the fish are presented in Table 2. Scales and digestive tract were the major non-usable parts of the fish accounting for 7.5 and 3.6% of the total weight of fish respectively. Gonads though constituting an average of 4.5% of the fish weight, had a very large variation. The extreme variation in the gonadal weight of *H. pulchellus* has been observed earlier (Sridhar et al., 2014), who speculate that the fish has an extended spawning period. Non-usable parts and head together constituted 30% of the weight of fish, yielding a headless dressed weight of about 70%. The proximate composition of *H. pulchellus* by the

Table 2. Dressing % and offal composition of *H. pulchellus* harvested during summer 2014. n=10

| Dressed Carcass traits | Value, g (% of total weight) |
|---|---|
| Head | 213±106 (9.9) |
| Gonads | 97±100 (4.5) |
| Offal | |
| Digestive tract | 78±48 (3.6) |
| Fins | 41±22 (1.9) |
| Gills | 22±8 (1.0) |
| Liver | 23±5 (1.1) |
| Scales | 160±40 (7.5) |
| Swim bladder | 9±4 (0.4) |
| Non usable parts (including head) | 643±208 (30.3) |
| Dressed body weight | 1714±608 (79) |
| Dressed headless body weight | 1501±514 (70.0) |

3 sections and averaged for the whole fish is given in Table 3. It was seen that moisture increased slightly from 1st BS towards the 3rd that is from head to tail, while the fat decreased in the same direction. Cutability or meat yield from different sections of *H. pulchellus* was similar to the yields obtained in case of other carps like rohu, catla, mrigal and hilsa, but silver carp appears to be an exception as its first and second BS yield nearly equal amounts of flesh (60.7 and 64.1% respectively), while the third BS yields an even higher meat% (75.4%) (Sahu et al., 2013a;b; 2014a;b). The meat yield from the three major sections in *H. pulchellus* and other carps appears to be a direct function of size of the section, with the bigger sections yielding greater quantities of meat. The head however contained little flesh and proportionately the most bone in *H. pulchellus*.

Variation in the fat content of the three major sections was discernible in *H. pulchellus*, with higher fat content in the anterior sections but the differences were not significant. However, higher fat contents in the anterior body sections are found clearly in rohu, catla, mrigal and silver carp (Sahu et al., 2013a;b; 2014a), but these differences were not pronounced in hilsa (Sahu et al., 2014b). Higher fat contents have been observed in Indian major carps of bigger sizes (Paul et al., 2015). Cereal dominant diets have been shown to increase fat content of skinless fillet, viscera and residual carcass compared to lupin and zooplankton diets in common carp (Oberle et al., 1997). Differences in protein content between sections of pulchellus was not significant as observed in catla and mrigal but such differences have been reported in hilsa and silver carp (Sahu et al., 2013b; 2014a;b). Rohu of different sizes did not show marked differences in protein, but ash contents were lower in bigger sized fish (Paul et al., 2015). *H. pulchellus* had higher protein and fat but lower ash contents than reported for rohu, catla or mrigal of comparable weight (Paul et al., 2015), making it better nutritionally. The small differences in proximate composition between sections of *H. pulchellus* were also reflected in the lack of differences between the taste panel scores.

No particular trends were seen in the concentrations of protein and ash in the body parts. Overall, *H. pulchellus* is a medium fat and high protein fish with 5.3% fat and 23% protein. The mean panel scores for rating of the three sections are shown in Table 4. The third BS was graded slightly higher than the other two sections, but the difference was not significant. Comments from the panelists indicated that the cooked fish texture was softer when compared to the major carps. Bulk of the meat in *H. pulchellus* is distributed in its anterior parts namely the first and second body sections. The fish has a good dressing yield, meat:bone ratio and

Table 3. Proximate composition of the head, first, second and third body sections of *Hypselobarbus pulchellus* harvested in summer 2014 on wet weight basis, % (n=10)

| Component | Head | 1st body section | 2nd body section | 3rd body section | Average |
|---|---|---|---|---|---|
| Moisture | 73.89±1.4 [a] | 72.3±5.9 [a] | 73.2±4.2 [a] | 73.5±3.7 [a] | 73.2±0.7 |
| Protein (TNx6.25) | 23.7±0.2 [a] | 22.4±0.8 [a] | 23.3±1.9 [a] | 23.6±1.5 [a] | 23.3±0.6 |
| Fat | 6.3±0.2 [a] | 6.9±0.9 [a] | 4.5±2.2 [a] | 3.4±0.9 [a] | 5.3±1.630 |
| Ash | 1.2±0.2 [a] | 1.2±0.1 [a] | 1.5±0.3 [a] | 1.6±0.8 [a] | 1.4±0.2 |

[*]Values in a row followed by the same superscript are not significantly different from each other ($p>0.05$)

Table 4. Hedonic taste panel scores* of the body sections of *Hypselobarbus pulchellus* harvested in summer 2014 (n=10)

| Body cut | Mean grading scores |
|---|---|
| First body section | 5.2±1.09 [a] |
| Second body section | 4.6±0.55 [a] |
| Third body section | 6.0±0.71 [a] |

Hedonic scale employed with value of scores in parenthesis: Like extremely (7)- Like moderately (6)- Like slightly (5)-Neither like nor dislike(4)- Dislike slightly (3)-Dislike moderately (2)-Dislike extremely (1).

* Scores followed by the same superscript are not significantly different from each other (p>0.05)

proximate composition. However, the effect of size, sex and maturity on the carcass characteristics of the fish are yet to be studied which are required to determine the best or optimal conditions for its harvest.

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