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Digestive Enzymes in the Gut of Snakehead Fish *Parachanna obscura* (Gunter, 1861) (Channidae) in River Ose South Western Nigeria

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Abstract: The digestive enzymes in the gut of *Parachanna obscura* of River Ose, South Western Nigeria was investigated with respect to distribution and activity levels. The result showed that all the enzymes were present at varying levels of activity in the five gut regions namely, stomach, caecae, duodenum, ileum and rectum. Lipases was absent in the ileum and rectum. Lipase activity was highest in the duodenum and minimal in the stomach. Proteases were present in the entire gut. The peak of pepsin activity was found to occur in the stomach while the least occurred in the rectum. Glycosidases (Lactase and Maltase) were found present in the whole gut system while sucrase was absent. Lactase was recorded to have the highest activity in the stomach while it's least activity was found in the rectum. Peak activities were recorded for pepsin and glycosidases in the stomach while peak activities were recorded for lipases and trypsin in the duodenum. The order of distribution and relative activity of the enzymes in the gut of *P. obscura* correlate with its nature of food.

Key words: *Parachanna obscura*, snakehead fish, river Ose, enzymes, glycossidases, proteases, lipase

INTRODUCTION

The African snakehead fish *Parachanna obscura* (Gunter, 1861) is one of the two species in the genera. It is a widely distributed freshwater fish endemic to Africa. They often attain large sizes and are found in commercial quantities wherever they occur. Olaosebiakn and Raji (1998) reported maximum size of 500 mm.

There are many published accounts on the digestive enzymes in the gut of some tropical fish (Akintude, 1985; Bitterlich, 1985; Chesley, 1934; Fagbenro, 1990; Fagbenro *et al*., 2001; Olatunde *et al*., 1988; Uys and Hecht, 1987) but none of these reported on the assay of digestive enzymes in the entire gut of African snakehead except (Fagbenro and Ogunlana, 2000) who reported only on the proteases of this fish. In culturable fish such information may be useful in the selection of food ingredients. In this study, the distribution and activity levels of lipases, proteases and glycosidases in the different gut regions (oesophagus, stomach, caeca, ileum and rectum) of *P.obscura* in River Ose were investigated with the aim of improving our knowledge of its digestive capabilities.

MATERIALS AND METHODS

Study area: The River Ose (265 km long) took its source from Apata Hills flows through Savanna and rainforest zones to discharge into the Atlantic Ocean through an intricate series of creeks and lagoons. The river which supports a thriving artisan fishery based on snakeheads, catfishes, tilapias and mormyriids has a reservoir built on it at Ose-Oba, Akoko in Ondo State.

Preparation of enzyme extract: Adult specimens were purchased alive from artisanal fishermen, kept in concrete tanks and starved for 72 h in order to bring them to the same physiological conditions.

The total and standard lengths and weights of the fishes were taken. The fishes were killed by a blow on the head and the entire gut (Oesophagus to Anus) were removed and measured. The different regions were cut out, tissues from 10 fish were pooled and homogenized using cold neutralized 1.0% potassium hydroxide. The homogenates were centrifuged at maximum revolution per minute for 30 min at 4°C to remove extraneous substrates. The clear supernatant was used as crude enzymes solution without purification.

Qualitative and quantitative analysis of proteases: Qualitative analysis of trypsin and pepsin in the gut of *Parachanna obscura* was carried out using the methods described by Balogun and Fisher (1970).

Quantitative analysis of the activity of proteases in the gut of *P. obsucra* followed the method of Rinderknecht *et al*. (1968).

Qualitative and quantitative analysis of glycosidases: The glycosidases in the gut of *P.obscura* was determined qualitatively using 0.4 mL of 1% substrate (maltose, sucrose, lactose and starch), 0.2 cm^3 phosphate buffer (pH 8) and 0.1 cm^3 of the enzyme extract. Quantitative determination of glycosidases in the gut of *P.obscura* was carried out using the Dinitrosalicybate (DNS) method described by Plummer (1978).

Qualitative and quantitative analysis of lipase: The qualitative and quantitative activity of lipase was carried out at 37°C as described by Ogunbiyi and Okon (1976).

RESULTS

Qualitative and quantitative determination of glycosidases: Table 1 presents the result obtained from the qualitative determination of glycosidase activities in the gut of *P. oscura*. It was observed that the enzyme sucrase was absent in the gut of this fish while lactase, maltase and amylase were present. It was observed that lactase was present at a considerable quantity in the regions analysed with the highest activity in the stomach. In the quantitative analysis of glycosidases in the gut of *P. obscura*, it was observed that there was variability of enzymes at the different regions of the gut. The highest glycosidase activity was in the stomach while the lowest was in the rectum. This is as presented in Fig. 1.

Qualitative and quantitative determination of proteases: Table 3 presents the results of the qualitative analysis of proteases in the gut of *P.obscura*. The result shows that proteases were detected in the regions of the gut except the oesophagus and rectum. The enzymes were found at varying levels in these regions with the stomach recording the highest level for pepsin while trypsin have the highest activity in the duodenum.

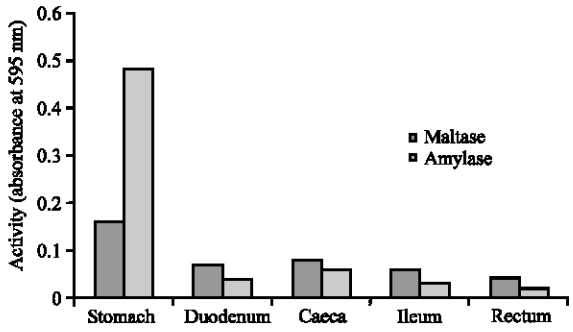

Fig. 1: Distribution of Maltase and Amylase activity in the digestive tract of *P. obscura*

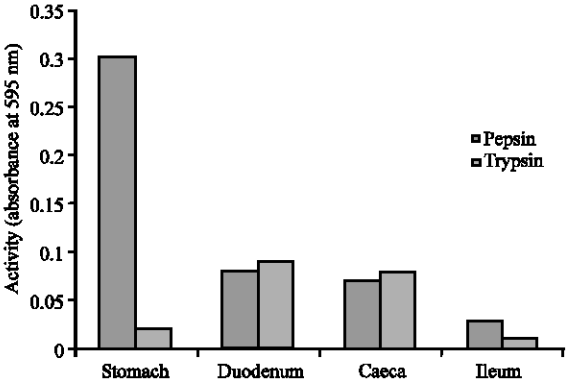

Fig. 2: Distrebution of Pepsin and Trypsin activity in the digestive tract of *P. obscura*

Table 1: Qualitative distribution of glycosidase in the gut of *P. obscura*

	Lactase	Maltase	Amylase	Sucrase
Oesophagus	-	-	-	-
Stomach	+++	+++	+++	-
Caeca	++	+-+	++	-
Duodenum	++	++	++	-
Ileum	++	+	+	-
Rectum	++	+	+	-

Keys: +++ high enzyme activity, ++ average activity, + low activityno activity

Table 2: Quantitative Determination of Glycosidases in the Gut of *P. obscura* Read at 595 nm

Enzyme	Substrate hydrolysed	Oestophagus	Stomach	Caecum	Duodenum	Ileum	Rectum
Lactase	Lactose	0.00	0.54±0.084	0.049±0.025	0.042±0.012	0.038±0.08	0.033±0.012
Maltase	Maltose	0.00	0.17±0.06	0.082±0.034	0.068±0.002	0.058±0.002	0.047±0.02
Amylase	Starch	0.00	0.48±0.013	0.006±0.038	0.045±0.006	0.004±0.008	0.002±0.001

Table 3: Qualitative distribution of Proteases and Lipase in the gut of *P. obscura*

	Trypsin	Pepsin	Lipase
Oesophagus	-	-	-
Stomach	+	+++	+
Caeca	+++	++	+++
Duodenum	+++	++	+++
Ileum	++	+	++
Rectum	-	-	+

Keys: +++ high enzyme activity, ++ average activity, + low activity,- no activity.

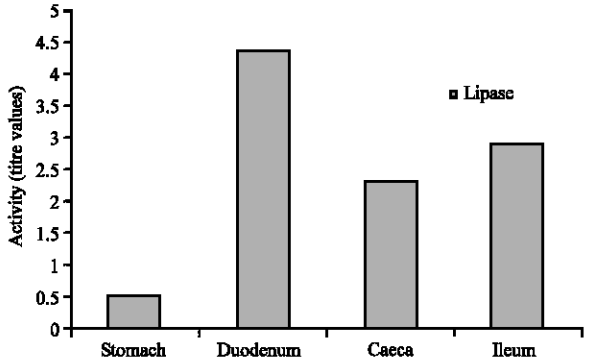

Fig. 3: Distribution of Lipase activity in the digestive tract of *P. obscura*

Qualitative and quantitative determination of lipases: Figure 3 shows the results obtained in the analysis of lipases in the gut of *P. oscurus*. The result shows that lipase activity was very high in the duodenum, ileum and caeca. The activity was low in the stomach and rectum, but no activity in the oesophagus.

Figure 2 presents the quantitative analysis of proteases in the gut of *P. obscura*. It shows that high activity of proteases occurred in the stomach than the other regions. Pepsin have the highest activity in the stomach while trypsin was highest in the duodenum.

DISCUSSION

The results obtained from this study showed that *Paracahanna obscura* is well equipped with the principal enzymes namely, glycosidases, proteases and lipase to digest its food items. Lee and Ng (1994) reported that snakeheads are highly predacious many preferring other fishes, crustaceans, frogs and smaller reptiles as food (1979).

The results of this research revealed that digestion in *Parachanna obscura* normally begins in the stomach and ends in the ileum. The absence of digestive enzyme activity in the oesophagus and very low enzyme activity in the rectum shows that the oesophagus is just a passage for food while the rectum is to store undigested materials or waste before they are eliminated from the body.

Of all the glycosidase tested for, only sucrase activity was not recorded but analysis of the diets of *P. obscura* showed that the food consists mainly fish. It is therefore surprising that maltase, amylase and lactase activity was recorded despite the fact that its diet did not include plant materials. The presence of relatively high glycosidases activity might be attributed to the exogenous enzymes from the prey consumed by the fish since *P. obscura* is a piscivore that feeds on other fishes which include *Tilapia zilli* a herbivore. This agrees with the report of Olatunde and Ogunbiyi (1988), Fagbenro *et al.* (2001).

Protein digestion started in the stomach where pepsin activity was very high, average in the caeca and duodenum but low in the ileum with no activity recorded in the rectum.

The high peptic activity recorded in *P. obscura* agrees with the work of Fagbenro *et al.* (2001) in the gut of African electric catfish, *Malapterurus electricus*.

The high intensity of pepsin in the stomach of *P. obscura* suggest the consumption of protein-rich diet. Hsu and Wu (1993) similarly recorded high peptic activity in several carnivorous species of freshwater fishes.

The occurrence of trypsin an alkaline protease in the stomach of *P. obscura* (Table 3) which is rare is worthy of note. However, Fagbenro *et al.* (2000) reported the presence of trypsin in the gut of *Heterobranchus bidorsalis*.

The high pepsin and trypsin activities can be attributed to the fact that *P. obscura* is a piscivorous species that consume protein-rich diets. This is similar to what is observed in other fishes that consume protein rich diet such as *Heterobranchus bidorsalis* (2000) *P. pellucida*, *E. niloticus* and *S. mystus* (1988). Protein activities was initiated by pepsin and completed with the addition of trypsin.

Digestion of fats takes place in the presence of lipase. The lipase distribution and activity in the gut of *P. obscura* (Fig. 3) is similar to what was observed in *Heterotis niloticus* by Fagbenro (1990) and in *Clarias isheriensis* reported by Fagbenro (1990). The activity of lipase being very high in duodenum, average in caeca and ileum but very low in the stomach and absent in the oesophagus and rectum is in conformity with the report of (Olatunde and Ogunbiyi, 1977). Digestion of fats is almost completed in the duodenum due to the high lipase activity observed in this region. The undigested fats in the duodenum were, however digested finally in the ileum. From the foregoing, it is evident that *P. obscura* is well equipped to digest carbohydrate, protein and lipid components of its piscivorous diet.

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