Nutrient Requirement of African Sneakhead Fish (Parachanna obscura, Gunther 1861): a Review

Juste Vital Vodounnou, Diane N.S. Kpogue, Jule Zounon, Wilfried Sintondji, Emile D. Fiogbe

Abstract
The domestication of new species in aquaculture, strongly contributed to the promotion of the aquaculture in the recent years. Fish need lipids, energy, protein vitamins and minerals in their feed for to insure growth, reproduction, and other physiological functions. Several studies have been made on P. obscura in sight of its domestication. Dietary protein requirement, dietary lipid requirement and dietary carbohydrate requirement of P. obscura were previously studied. The aim of this study is to make a bibliographical on the nutrient requirements of the African snakehead fish (P. obscura) in order to promote P. obscura rearing.

Keywords
Parachanna obscura; Protein requirements; Carbohydrate requirements; Lipid requirements

Background
Aquaculture is an important part of agriculture because it generates products (fishes, crustaceans, mollusks, algae) of same nature than those issued from natural marine and continental fisheries (Naylor et al., 2000; Pauly et al., 2002; Priyadarshini et al., 2015; Adewole and Futuroti, 2017; Adamneh and Abelneh, 2018). As marginal in relation to natural fishery volume until 1970s, aquaculture has developed explosively from middle 1980s and now represents the agricultural production with the highest growth rate during the last fifteen years on the world scale (14% yearly between 1990 and 2000 against 2.8% for terrestrial animal productions in the same period) (El-Sayed, 1994; Ramachandran et al., 2005). The domestication of new species in aquaculture, strongly contributed to the promotion of the aquaculture the last years. The domestication of a new fish species is done by the control of its environment, its reproduction and its feed. The control of the feeding is done by the determination of the nutritional requirements on the quantitative level and the qualitative level (Kpogue, 2013a; Olufeseagba et al., 2017; Vodounnou et al., 2017). Fish rearing requires the knowledge of the requirements in proteins, lipid, energy and vitamins of the species in order to ensure a good growth to him. These diets vary according to the species, the stage of development, stage of life, sex, age and the environment (Reinitz, 1983; Rembold and Fluchter, 1988). The feed for cultured fish can come from various natural sources, such as the plankton, bacteria, insects and other fish in the ecosystem, and artificial feed (Mgbenka and Lovell, 1985; Miwa and Innui, 1987).

Parachanna obscura is found in West African country and central African country (Kumar et al., 2012). African snakehead, P. obscura flesh is very much appreciated by African consumers. It has high economic value for aquaculture since it has better growth rate (2 g/day), few bones, tasty flesh, accepts high stocking density and can use the atmospheric oxygen for respiration (Micha, 1974; Victor and Akpocha, 1992; Bolaji et al., 2011). It is a species having resistance to the stresses and is the most widespread species among all the species of African Chanidae (Bonou and Teugels, 1985). Several studies have been made on P. obscura in spite of its domestication. Dietary protein and lipid requirement, feeding rate, optimum stocking density and semi artificial reproduction of P. obscura were extensively investigated (Kpogue and Fiogbe, 2012a; 2012b; Kpogue et al., 2013a; Vodounnou et al., 2017). The aim of the study is to make a bibliographical sketch on the nutrient requirement of the African snakehead fish (P. obscura) in order to promote P. obscura rearing.
1 Materials and Methods
The data were collected from the articles of the journals, books and chapters of book, reports of workshop, and reports of FAO, unpublished reports, the memoirs and theses of doctorate. The documents were collected from the libraries of the University of Abomey-Calavi, of Halieutic Production Direction (DPH) in Benin, various researchers, and the data bases of internet.

2 Protein Requirements
In fish tissue, there is approximately 70% of protein of dry weight organic; therefore, protein content is one of the most essential nutritional compounds of feeds of the fish. Crude protein content is the general measure of fish feed quality, and is usually referenced when identifying specific fish feeds. Generally, the protein level of feed is directly proportional to the fish growth, if the level is within the range of approximately 20 to 40% crude protein. Optimum dietary protein levels vary with fish species, water temperature, feeding frequency, stage of life, daily feed allowance, quality of protein, and quantity of non-protein energy (Hancz, 2011).

The methods employed to determine the needs for protein, however, can over-estimate the needs, out of protein of the diet excessive or the amino acids, to be stored, are catabolized the carbohydrates and greases preferentially finished and are employed for energy by some fish (Wilson, 1989).

2.1 Protein requirement of Parachanna obscura larvae
The answer of increasing dietary protein on growth parameters, were determined in Parachanna obscura larvae. The initial body weight was 0.12 ± 0.01 g. Five semi-purified isoenergetic experimental diets were formulated (35, 45, 50, 55 and 60 g/100 g of diet). Growth parameters and feed utilization were influenced by dietary protein (p<0.05). Second degree polynomial regression and broken line models were used to analyze the relationships between dietary crude protein and SGR (Figure 1). Based on the results of it study, requirements of protein of P. obscura larvae are included between 45 and 55.5% of the diet (Kpogue et al., 2012c).

![Figure 1 Determination of maximum dietary protein requirement of P. obscura larvae according (Brett and Grove, 1979) method](image)

2.2 Protein requirement of Parachanna obscura fingerlings
The impact of increasing dietary protein on growth parameters, were determined in Parachanna obscura larvae. The initial body weight was 0.12 ± 0.01 g. Five-isoenergetic semi-purified diets were formulated to evaluate the effects of dietary crude protein levels on growth and feed utilization of snakehead, Parachanna obscura (4.08 ± 0.07 g). Experimental diets were formulated to contain graded levels of crude protein (CP; 30, 40, 45, 50 and 60 g/100 g of diet). Growth performances and nutrient utilization parameters of fingerlings fed different diets varied significantly (p<0.05) (Figure 2). The relationship between the dietary CP and specific growth rate (SGR) indicated that protein requirements of P. obscura fingerlings ranged from 42.5 to 53.5% of diet (Kpogue et al., 2013b).
3 Carbohydrates Requirement
The requirement of the carbohydrates changes according to species of fish. The fish of warm-water can employ quantities much higher of diet carbohydrate than cold water fish and marine fish. The requirements in carbohydrate are difficult to evaluate in the diets, however if carbohydrates are not provided in the diet, other components such as protein and lipids, are catabolized for energy and for the synthesis of various biologically significant compounds. Thus, it is significant to provide the suitable concentration of the carbohydrate according to the mode cultivation (Sub-committee on Nutrition fish, 1993). The use of the carbohydrates in the diets of fish changes according to the complexity of the carbohydrate.

Figure 2 Second degree relationship between specific growth rate and dietary protein levels according (Brett and Grove, 1979) method

3.1 Carbohydrates requirement of Parachanna obscura fingerlings
Some study during 8 weeks was realized in order to evaluate the dietary effect of carbohydrate rate on zootechnical performances of Parachanna obscura fingerlings. Five experimental diets were formulated to contain graded rates of carbohydrate (6, 8, 10, 12 and 14%). Each diet was tested in triplicate. Zootechnical performances improved significantly (p<0.05) as dietary carbohydrate level increased. Best specific growth rate and feed efficiency were obtained with diets containing 12% of carbohydrate. In conclusion, the optimal carbohydrate requirement of P. obscura fingerlings is 12% of diet (Kpogue et al., 2018).

4 Lipid Requirement
The lipids of the diets are significant sources of energy and essential fatty acids which are necessary for the growth and the development of the fish. It also contributes to the absorption of large soluble vitamins. Lipids of the diets, mainly in the form of triacylglycerol, are hydrolyzed by the digestive enzymes with a mixture of the free fatty acids and 2-monoglycerides. These compounds then are absorbed and used for the synthesis of cellular different components or catabolized for energy. The lipids of the diets of fish contain the saturated and unsaturated fatty acids. Fatty acids can be indicated by the numbering of the methyl or carboxylic terminal. The notation of the methyl terminal is most convenient for many feed goals. The insatured fatty acid refers normally to the acids fatty with 18 atoms of carbon or more and the bonds two or double (Sub-committee on Nutrition fish, 1993).

4.1 Lipid requirement of Parachanna obscura fingerlings
Five iso-energetic diets were formulated to evaluate the effects of lipid on growth parameters, of African Snakehead P. obscura fingerlings. The initial body weight was 7.69 ± 0.14 g. The experimental diets contained graded rate of lipid (5, 7, 9, 11 and 14 g/100 g of diet). Growth performances and nutrient utilization parameters of fingerlings fed on different diets varied significantly (p<0.05). Highest growth performances and nutrient utilization were obtained with fish fed on a diet containing 7% of crude lipid. According to the broken line models
used to analyze the relationships between the dietary crude lipid and the specific growth rate (SGR), the maximum dietary crude lipid requirement is 7% of the diet (Figure 3) (Kpogue, 2013a).

5 Conclusion
At the end of this study of the aim is to make a bibliographical synthesis on the nutrient requirement of the African snakehead fish (P. obscura) in order to promote P. obscura rearing we can to stop that: Requirements of protein of P. obscura larvae are included between 45 and 55.5% of the diet. Requirements of protein of P. obscura fingerlings are included between 42.5 and 53.5% of the diet. The optimal carbohydrate requirement of P. obscura fingerlings is 12% of diet. The maximum dietary crude lipid requirement is 7% of the diet.

Authors’ contributions
All authors have made adequate effort on all parts of the work necessary for the development of this manuscript according to his/her expertise. All authors read and approved the final manuscript.

Acknowledgements
I acknowledged all authors having worked on P. obscura and whose results made it possible to make this bibliographical synthesis.

References
Adamneh D., and Abelneh Y., 2018, Growth performance of three Nile tilapia (Oreochromis niloticus L., 1758) populations in pond system, International Journal of Aquaculture, 8(9): 65-72
https://doi.org/10.5376/ija.2018.08.0009

Adewole A.M., and Fatiroti E.O., 2017, Effects of basil leaf (Ocimum gratissimum) as dietary additives on growth performance and production economics of Clarias gariepinus, International Journal of Aquaculture, 7(6): 42-50
https://doi.org/10.5376/ija.2017.07.0006

Bolaji B.B., Mfon T.U., and Utibe D.I., 2011, Preliminary study on the aspects of the biology of snakehead fish Parachanna obscura (Gunther) in a Nigerian wetland, African Journal of Food and Agriculture Nutrition Development, 11(2): 4708-4717
https://doi.org/10.4314/afand.v11i2.65923

Bonou C.A., and Teugels G.G., 1985, Révision systématique du genre Parachanna (Teugels & Daget, 1984) (Pisces: Channidae), Rev. Hydro. Tropi., 18: 267
http://agris.fao.org/agris-search/search.do?recordID=AV2012068575

Brett J.R., and Grove T.D.D., 1979, Physiological energetic, In: W.S. Hoar, D.J. Randall, J.R. Brett (Eds.), Fish Physiology, Bioenergetics and Growth, vol. VIII, Academic Press, New York, 279-352
https://doi.org/10.1016/S1546-5098(08)60029-1

El-Sayed A.F.M., 1994, Evaluation of soybean meal, spirulina meal and chicken offal meal as protein sources for silver seabream Rhabdosargus sarba, Aquaculture, 127: 169-176
https://doi.org/10.1016/0044-8486(94)90423-5

Kpogue D.N.S., d’Almeida F.M.A., Odjo I., and Fiogbe D.E., 2018, Utilisation des glucides chez les alevins de Parachanna obscura élevés en milieu contrôlé, Int. J. Biol. Chem. Sci., 12(1): 286-293
https://doi.org/10.4314/ijbcs.v12i1.23

Kpogue D.N.S., 2013a, Domestication de Parachanna obscura (Günther,1861) au Bénin: Besoins nutritionnels et densités de mise en charge, Thèse présentée en vue de l'obtention du grade de docteur en sciences de l'université d'Abomey-Calavi, pp.153

Figure 3 Determination of maximum dietary lipid requirement of P. obscura fingerlings according to the broken line model
Kpogue D.N.S., Ayanou G.A., Toko II, Mensah G.A., and Fiogbe E.D., 2013b, Influence of dietary protein levels on growth, feed utilization and carcass composition of snakehead, Parachanna obscura (Günther, 1861) fingerlings, Academic Journals, 5(5): 71-77
http://www.academicjournals.org/journal/AJF/article-full-text-pdf/5560FF87752

Kpogue D.N.S., and Fiogbe E.D., 2012a, Feeding rate requirements for Parachanna obscura fry reared under controlled environmental conditions, Journal of Applied Biosciences, 55: 3962-3972
http://ejm.elewa.org/JABS/2012/55/3.pdf

Kpogue D.N.S., and Fiogbe E.D., 2012b, Optimum stocking density for Parachanna obscura larvae fed at its optimum ration, International Journal of Biological and Chemical Sciences, 6(3): 1293-1302
https://doi.org/10.4314/ijbcs.v6i3.32

Kpogue D., Gangbazo H., and Fiogbe E., 2012c, A preliminary study on the dietary protein requirement of Parachanna obscura (Günther, 1861) larvae, Turkish Journal of Fisheries and Aquatic Sciences, 13: 111-117
https://doi.org/10.4194/1303-2712-v13_1_14

Kumar K., Kumar R., Saurabh S., Sahoo M., Mohanty A.K., Lalrinsanga P.L., Mohanty U.L., Sahu A.K., and Jayasankar P., 2012, Snakehead fishes fact sheets, Central Institute of Fresh Water Aquaculture, Kausalyaganga, Bhubaneswar-751 002, Odisha, India
http://krishikosh.egranth.ac.in/bitstream/1/50305/1/Snake%20Head%20Fact%20Sheets.pdf

Mgbenka B.O., and Lovell R.T., 1985, Feeding combinations of extruded and pelleted feeds to channel catfish in ponds, Prog. Fish Cult., 48: 238-241
https://doi.org/10.1577/1548-8640(1985)48<238:IFOGCI>2.0.CO;2

Micha J.C., 1974, Fish populations study of Ubangi river: trying local wild species for fish culture, Aquaculture, 4: 85-87
https://doi.org/10.1016/0044-8486(74)90022-2

Miwa S., and Inui Y., 1987, Effect of various doses of thyroxine and triiodothyronine on the metamorphosis of flounder (Paralichthys divaues), Gen. Comp. Endocrinol., 67: 356-363
https://doi.org/10.1016/0044-8486(87)90190-0

Naylor R.L., Lubchenco J., and Christensen V., Guénette S., Pitcher T.J., Sumaila R.U., Walters C.J., Watson R., and Zeller D., 2002, Towards sustainability of world fish supplies: A blueprint for action, Science, 298: 239–242
https://doi.org/10.1038/nature01017

Olufegha S.O., Okomoda V.T., and Adega T., 2017, Growth performance and nutrient utilization of hormonal sex-reversed male and mixed sex Oreochromis niloticus under outdoor rearing condition, International Journal of Aquaculture, 7(16): 106-110
https://doi.org/10.5372/iija.2017.07.0016

Pauly D., Christensen V., Guénette S., Pitcher T.J., Sumaila R.U., Walters C.J., Watson R., and Zeller D., 2002, Towards sustainability in world fisheries, Nature, 418: 689-695
https://doi.org/10.1038/nature01017
PMid:12167876

Priyadarshini M., Maniserry J.K., Gangadhar B., Rao L.M., and Keshavanath P., 2015, Growth performance, body composition and digestive enzyme activity of common carp (Cyprinus carpio) fry fed on soybean and horse gram supplemented diets, International Journal of Aquaculture, 5(17): 1-7
https://doi.org/10.5372/iija.2015.05.0017

Ramachandran S., Bairagi A., and Ray A.K., 2005, Improvement of nutritive value of grass pea (Lathyrus sativus) seed meal in the formulated diets for rohu, Labeo rohita (Hamilton) fingerlings after fermentation with a fish gut bacterium, Bioresource Technology, 96: 1465-1472
https://doi.org/10.1016/j.biortech.2004.12.002
PMid:15939274

Reinitz G., 1983, Relative effect of age, diet, and feeding rate on the body composition of young rainbow trout (Salmo gairdneri), Aquaculture, 35: 19-27
https://doi.org/10.1016/0044-8486(83)90067-4

Rembold H., and Fluchter J., 1988, Nutritional factor enabling metamorphosis of coregonid larvae, Finnish Fish Res., 9: 339-343
https://books.google.ca/books

Subcommittee on Fish Nutrition, National Research Council, 1993, Nutrient Requirements of Fish, ISBN: 0-309-59629-7, pp. 124
https://www.nap.edu/catalog/2115.html

Victor R., and Akpocha B.O., 1992, The biology of snakehead, Channa obscura (Gunther), in a Nigerian pond under monoculture, Aquaculture, 101: 17-24
https://doi.org/10.1016/0044-8486(92)90522-D

Vodounou D.S.I.V., Kpogue D.N.S., Akpo Y., and Fiogbe E.D., 2017, Determination of sexual dimorphism of African snakehead (Parachanna obscura): morphometric and meristic parameters, weight-length relationship and condition factor, International Journal of Biology and Chemical Sciences, 11(4): 1742-1752
https://doi.org/10.4314/ijbcs.v11i4.26

Wilson R.P., 1989, Amino acids and proteins, pp.111-151 in Fish Nutrition, 2ed ed., J. E. Halver, ed. New York: Academic Press
https://www.jstor.org/stable/3033572