

Dietary Effects of *Desmodium* (*Desmodium adscendens*) Leaves on the Reproductive Indices in African Catfish (*Clarias gariepinus*) Broodstock

Israel Opeyemi Oke^{1,*} , Adekunle Ayokanmi Dada¹, Olayemi Razaq Saliu¹, Esther Bosede Kuyoro¹

¹Department of Fisheries and Aquaculture Technology, Federal University of Technology, P.M.B. 704, Akure, Ondo State, Nigeria.

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Corresponding Author

Tel.: +2348077890454
E-mail: oke_israel@yahoo.com

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Abstract

The effects of sweetheart plant (*Desmodium adscendens*) leaf powder on the reproductive indices of *Clarias gariepinus* was investigated in this study. 30 Male *C. gariepinus* (mean weight 325.7 ± 7.50g) and 30 female *C. gariepinus* (mean weight 330.97 ± 2.31g) were used for the experiment. Five diets with a crude protein of 40% were formulated with inclusion level of 0, 0.5, 1.0, 1.5, 2.0g of *Desmodium adscendens* leaf powder per 100g of basal feed designated as D1, D2, D3, D4, and D5 respectively. The fish were stocked in 20 concrete tanks (2m × 2m × 1.5m) at 3 fish/tank and water level maintained at 1m throughout. Male and female fish were stocked separately. The fish were fed at 3% body weight twice between 0800 and 1700 hours daily for 56 days. Male *C. gariepinus* broodstock fed 1.5 g of *Desmodium adscendens* leaf powder per 100g of basal feed had significantly higher ($P < 0.05$) sperm counts, percentage motility and milt volume. There was a significant difference ($P < 0.05$) in the weight of ovaries of female fish. The inclusion level of 1.5g and 2.0g of *D. adscendens* powder in 100g of basal feed improved the pro-fertility of male and female brood stock respectively.

Introduction

Aquaculture is the rational rearing of fish and other aquatic organisms in an enclosed water body (Nash, 2011). In Nigeria, fish farming is the most practiced form of aquaculture. Some of the challenges faced by fish farmers are quality feeds, quality fish seeds, and environmental factors. Fish reproduction under controlled conditions requires the obtaining of high quality sperm and egg from male and female fish brood stock respectively to produce the highest possible numbers of good quality seeds (Adeparusi *et al.*, 2010). Other factors that affect fish seeds quality includes different strains, genetics, nutrition, the content of feed and activities of modern agriculture which have

introduced several substances such as organic matter, chemical fertilizer, and insecticides into the water used for cultured medium (Conyurt and Akhan, 2008).

The need for high quality fish seed has necessitated the involvement of research in fertility enhancement to meet the growing demand for fish seeds (Dada, 2012). Medicinal plants are being investigated, evaluated and developed into drugs with little or no side effects (Oyedemi *et al.*, 2018). The use of medicinal plants as fertility enhancer in aquaculture has been receiving some attention due to shifting attention from synthetic drugs to natural plants products (Dada and Ebhodaghe, 2011). Biological studies have supported claims that natural plants have medicinal values and due to the

antioxidants in them, they have the tendency of enhancing fertility either directly or indirectly (Ashamu *et al.*, 2010; Oluyemi *et al.*, 2007). Fertility enhancing properties of some plants in Nigeria has been ascertained. Some of these plants include *Garcinia kola* (Dada and Ajilore, 2009), *Kigelia Africana* (Adeparusi *et al.*, 2010), *Tetracarpidium conophorum* (Adekunle and Aguda, 2015), *Sesamum indicum* and *Croton zambesicus* (Dada and Adeparusi, 2012).

Desmodium adscendens is a vine that grows well on the West Coast of Africa and in the Amazon rainforest of Peru. Native people use *D. adscendens* as juice or tea for medicinal purpose in different parts of the world (Muanda *et al.*, 2011). The leaves of this plant are used to treat leucorrhoea, body aches, pains, ovarian inflammations, excessive urination, gonorrhoea, and diarrhoeas (Muanda *et al.*, 2010). Its positive effect against hepatic infection was also verified in vivo (Heard, 1994). In African traditional medicine, *D. adscendens* is extensively used to treat asthma and other diseases associated with smooth muscle contraction (Gyamfi *et al.*, 1999). The extracts of *D. adscendens* leaves has been found to exhibit interesting antioxidant properties and reactive oxygen species scavenging activity. The presence of natural antioxidants in *D. adscendens* justified its use in folk medicine (Muanda *et al.*, 2010).

C. gariepinus is widely cultivated in Nigeria due to its ability to consume supplementary feed, good conversion of feed to flesh, resistance to disease, ability to reproduce in captivity, fast growth rate and tolerance to a wide range of environmental conditions (Ayinla, 1997). Many hatcheries in Nigeria are functional at low capacity producing only a total of some 30 million fingerlings per year (Dada and Fagbenro, 2008). The rapid growth of the fish farming sector is a reason to

focus on improved broodstocks for an increase in fish seeds production and control fertility in broodstocks. Therefore, the objective of this research is to examine the effectiveness of *Desmodium adscences* leaves powder as a fertility agent in fish seed production.

Material and Methods

Formulation of Experimental diets

Fresh leaves of *Desmodium adscendens* were collected from the oil palm plantation of the Federal University of Technology, Akure, Ondo-state. Identification and authentication were done at the Department of Crop, Soil and Pest Management, Federal University of Technology, Akure. The leaves were washed, air-dried at room temperature and pulverized into flour. Amounts of 0 (control), 0.5, 1.00, 1.5, 2.0 g of *D. adscendens* powder per 100g of feed were taken and mixed with a basal feed (40% Crude protein), containing fish meal, soybean meal, yellow maize, blood meal, vegetable oil, fish oil, vitamin premix and binder (starch). All dietary ingredients were milled. The ingredients were thoroughly mixed in a Hobart A-2007 (Hobart Ltd, London, UK) pelleting and mixing machine to obtain a homogenous mash. The resultant mash was pressed without steam through a mixer with 6mm die attached to the Hobart pelleting machine. The pellets were dried at ambient temperature (27-30°C) and kept in a cool dry place (Table 1).

Experimental Procedure

Ten concrete tanks (1x2x1.5m³) at the Department of Fisheries and Aquaculture Technology Fish Farm, Federal University of Technology, Akure. Five dietary

Table 1. Ingredients composition (kg) and proximate composition (%DM) basal diet

Ingredients	Treatments				
	D1	D2	D3	D4	D5
Fishmeal (65% cp)	25	25	25	25	25
Yellow maize	100	100	100	100	100
Soybean meal(45% cp)	35	35	35	35	35
Blood meal (85% cp)	10	10	10	10	10
Fish oil	6	6	6	6	6
Vegetable oil	4.0	3.5	3.0	2.5	2.0
Vitamin premix*	3	3	3	3	3
Starch	20	20	20	20	20
<i>D. adscendens</i> (g/kg) feed	0	0.5	1.0	1.5	2.0
Proximate Composition (%)					
Crude protein	39.75	40.01	40.12	40.23	40.35
Crude lipid	14.11	13.09	13.64	13.59	14.26
Crude fibre	3.30	2.90	2.12	2.20	3.61
Ash	14.60	15.53	17.90	15.18	19.05
NFE	22.42	23.80	19.73	23.63	18.40

*Vitamin premix: An Hi-mix® product

NFE: Nitrogen free extracts (((MC+CP+AC+EE+CF) – 100)

treatments (D1, D2, D3, D4, and D5) were set-up in duplicate at a stocking density of six fish per tank. Fish were fed at 3% body weight twice daily (0800 and 1700 hours). All fish were weighed fortnightly and feeding rates were adjusted consequently. The experiment lasted for 56 days. At the end of the experiment period the following reproductive indices were determined: ovaries weight (g), Egg number/fish, Egg number/Kg Body weight, Egg diameter for females and Testes weight (g), Milt count(105spz/ml), milt volume (ml), Motility (%), Motility duration (sec) for males. Gonado-somatic index for females and males was also determined.

Gonado-somatic index= (gonad weight (g) /total body weight (g)) x 100 (Abbas *et al.*, 2008).

Water quality parameters of experiment I varied as follows: dissolved oxygen, 6.07- 6.94 mg/l; temperature, 26.35 - 28.19°C; pH, 6.71- 7.53. Water quality results during experiment II were as follows: temperature, 26.00-26.04 °C; dissolved oxygen 4.20-4.40 mg/l; pH, 7.20-7.50. Physio-chemical properties of the water used in experiment I and II are within the recommended range for *C. gariepinus* (Bhatnagar *et al.*, 2010, APHA, 2002, Ekubo and Abowei, 2002).

Statistical Analysis

The effect of *D. adscendens* on the fertility of *C. gariepinus* brood stock was analysed using one-way analysis of variance (ANOVA) and significant difference among treatments were compared using Duncan multiple range test.

Results and Discussion

Experiment I- Reproductive performance of Female *C. gariepinus* Fed dietary supplementation of *D. adscendens*

Data on growth performance, ovaries weight, egg numbers are presented in Table 2. There was a

significant difference ($P < 0.05$) in the weight gain of fish fed the five prepared diets. There was no significant difference ($P > 0.05$) in the egg number, egg diameter, gonado-somatic index of fish fed the different diets. Yeldan and Avsar (2000) reported that Gonado-somatic Index (GSI) is used in order to examine the spawning period because its value is directly related to the development and quality of the gonad. There was no significant difference in the GSI across the treatments. The GSI recorded in this study is higher than those reported by Ekanem *et al.* (2017) using *S. jamaicensis* and *G. kola* on female African catfish. The result is also higher than the range reported by Eyo *et al.*, (2014) for female catfish feed with two different commercial diets. There was no significant difference in the GSI across treatments. Though there was no significant difference ($P < 0.05$) in the egg number per fish. The increase in egg number per fish obtained in this study could be as a result of the presence of bioflavonoids, xanthone and carotenoids in *D. adscendens* leaves (MacManus *et al.*, 1993; Asante-Poku *et al.*, 1988). Astaxanthin supplementation in cultured salmon and red sea bream increased ovary development, fertilization, hatching and larval growth (Torrissen and Christiansen, 1995). Adesanya *et al.* (2007) reported that bioflavonoids and xanthone are potent antioxidants capable of increasing the production of oestrogen, a key hormone in production and maturation of eggs in the ovaries.

Experiment II- Reproductive performance of Male *C. gariepinus* Fed dietary supplementation of *D. adscendens*

The average initial weight of male *C. gariepinus* used for the experiment was 325.74±7.50g. Results on growth performance in Table 3 show that weight gain was highest in fish fed D5 (20gkg⁻¹ of *D. adscendens* powder) compared to other diets. There was no significant difference ($P > 0.05$) in the lengths of fish fed different experimental diets. There was a significant difference ($P < 0.05$) in the milt count, motility, milt

Table 2. Female sexual parameters of *C. gariepinus* brood stock as affected by dietary supplementation of *D. adscendens*

Parameter	Treatments				
	D1	D2	D3	D4	D5
Initial Fish weight (g)	327.6±2.3 ^a	332.9±2.6 ^a	329.9±2.6 ^a	334.1±3.10 ^a	330.3±1.1 ^a
Final Fish Weight (g)	511.7±6.5 ^b	509.6±18.2 ^b	499.3±5.5 ^a	534.7±16.3 ^b	492.3±0.5 ^a
Weight gain (g)	183.9±4.3 ^a	176.8±20.6 ^b	169.4±2.9 ^a	200.6±13.2 ^b	162.1±0.6 ^a
Ovaries Weight (g)	94.7±0.26 ^a	90.8±5.62 ^a	100.2±1.5 ^b	97.0±1.8 ^a	100.2±3.6 ^b
Egg Number/Fish (x10 ³)	47.80±2.7	48.30±8.4	51.28±1.9	56.00±8.6	56.6±7.7
Egg Number/Kg (x10 ³)	259.83	273.25	302.69	279.19	349.12
BW**					
Egg Diameter	1.50±0.00	1.50±0.00	1.55±0.05	1.60±0.00	1.60±0.00
GSI	18.70±1.77	17.31±0.91	20.0±1.23	17.12±2.01	17.93±1.19

Means in the same row with the same superscript are not significantly different ($P > 0.05$)

GSI= Gonado –somatic index

**BW= Body Weight

Table 3. Male sexual parameters of *C. gariepinus* brood stock as affected by dietary supplementation of *D. adscendences*

Parameter	Treatments				
	D1	D2	D3	D4	D5
Fish weight (g)	452.8±53.2 ^a	488.4±5.55 ^{ab}	562.35±2.15 ^c	500.00±30.25 ^{ab}	576.80±31.40 ^c
Length of fish (cm)	40.40±1.00 ^a	40.80±1.10 ^a	43.05±0.15 ^a	41.20±1.40 ^a	43.10±0.00 ^a
Milt count (x10 ⁵ spz/ml)	1.60±0.13 ^a	1.75±0.05 ^{ab}	1.97±0.14 ^{ab}	1.91±0.04 ^{ab}	2.29±0.33 ^c
Milt volume (ml)	0.50±0.10 ^a	0.40±0.00 ^a	0.75±0.05 ^b	0.65±0.05 ^b	0.75±0.05 ^b
Motility (%)	55.95±1.65 ^a	56.50±2.70 ^a	63.65±4.45 ^{ab}	78.80±2.35 ^c	72.75±0.95 ^{bc}
Motility duration (sec)	2.76±0.40 ^a	2.59±0.51 ^a	2.85±0.44 ^{ab}	3.46±0.05 ^b	3.33±0.80 ^{bc}
GSI	0.65±0.00	0.57±0.10	0.64±0.03	0.65±0.00	0.42±0.02

Means in the same row with the same superscript are not significantly different (P>0.05)

GSI= Gonado –somatic index

volume, weight of testes and gonado-somatic index of experimental fish after feeding trial for 56 days. Reproductive indices of the male *C. gariepinus* breeders in this experiment shows that inclusion of *D. adscendences* leaf powder had effects on the testes weight, milt motility, gonado-somatic index, and milt volume. The GSI recorded in this study is lower than that recorded in the works of Ekanem *et al.* (2017). Results of works done by Dada *et al.* (2011) and Igoli *et al.* (2005), also reported an increase in the reproductive indices of male *C. gariepinus* broodstocks using *Mucuna puriensi* as a pro-fertility agent in their study. The length of time and intensity of spermatozoa motility, percentage motile sperm, and sperm density are all parameters that have been measured in an attempt to assess sperm quality in human, mammals, and fish (Billard and Cosson, 1992). Motility of the spermatozoan is the most commonly used indicator of milt quality since high motility is a prerequisite for fertilization and correlates strongly with fertilization success (Rurangwa *et al.*, 2001). Percentage motility recorded in this study is similar to result of Dada and Fagbohun, (2018) using Date palm seed powder on *C. gariepinus* male broodstock. There was significant difference in the percentage motility of sperm in the experimental fish across different treatment. The highest percentage motility was recorded in fish fed diet containing 15gkg⁻¹ *D. adscendences* powder. There was no significant difference (P<0.05) in the milt count of the male *C. gariepinus* broodstock fed the control and D5 diets. Male *C. gariepinus* broodstock fed diet 4 had the best gonado-somatic index value, motility duration, and motility. This reveals that the best inclusion level of *D. adscendences* is at 15gkg⁻¹.

Conclusion

In conclusion, the inclusion of *Desmodium adscendences* leaves powder at 1.5g/100g in the diet of male *Clarias gariepinus* broodstock and 2.0g/100g in the diet of female *Clarias gariepinus* brood stock will improve the gamete quality of both female and male. This implies that *Desmodium adscendences* leaves have

pro-fertility properties which could be a future prospect in the production of quality and adequate fish seeds.

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