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Proximate Composition and Sensory Qualities of African Catfish Fed Black Soldier Fly, *Hermetia Illucens,* as a Dietary Protein Supplement

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Abstract
Evaluation of alternative protein sources in replacement of fish meal is of necessity in aquaculture as well as investigation of organoleptic properties and consumer acceptability of fish fed by such alternatives. This study investigated the proximate composition and sensory qualities of dried *Clarias gariepinus* fed 0%, 25%, 50%, 75% and 100% Black Soldier Fly (BSF) prepupae meal in replacement of fish meal for 12 weeks. Results revealed that, the proximate composition of *C. gariepinus* fed BSF prepupae meal were significantly different ($p<0.05$) from those fed the control diet. *C. gariepinus* fed 100% BSF prepupae meal had the highest ether extracts and ash values. The inclusion of BSF prepupae meal had no significant effect on most of the sensory qualities except for appearance in which *C. gariepinus* fed 75% level was significantly ($p<0.05$) rated higher than fish from other diets. Inclusion of BSF prepupae meal at all levels had no significant effect on consumers' acceptability of the fish product.

Key words: BSF prepupae, sensory qualities, acceptability, *Clarias gariepinus.*

Introduction

Fish is desired primarily for human consumption because of its high quality and easily digestible protein. Fish is also a good source of essential fatty acids and mineral nutrients. Evaluation of alternative protein sources is of necessity for fish nutritionists and for enhancement of profitability of aquaculture venture. However, before feedstuffs can be recommended for inclusion into animal/fish feed, evaluation of the growth performance, biochemical analysis of fish fed with the feed stuffs organoleptic properties and acceptance by consumers should be investigated (Carl *et al.*, 1993).

Reduction in fish growth and changes in fillet quality have been reported when attempting to replace fish meal protein with alternative animal- or plant-derived ingredients (D'Souza *et al.*, 2006; Sealy *et al.*, 2011, Adeniyi and Folorunsho, 2015). Previous research indicated that, potential exists for the utilization of BSF prepupae as a feed ingredient for rainbow trout (St-Hailare *et al.*, 2007, Stamer, 2014) and for African catfish up to 75% inclusion level in replacement of fish meal (Adeniyi and Folorunsho, 2015). Proximate composition and sensory qualities of smoked African catfish have been reported by Agbabiaka *et al.* (2012) and Obande *et al.* (2012). However, there is paucity of information on the influence of alternative protein sources in replacement of fish meal on the nutritional and sensory qualities of African catfish. Therefore, this study was carried out to investigate the effect of replacing fish meal with Black Soldier Fly (BSF), *Hermetia illucens*, prepupae meal on the proximate composition and sensory qualities of African catfish, *Clarias gariepinus*.

Materials and Methods

Drying and proximate analysis of fish samples:
Samples of fish were taken from tanks of each treatment of *C. gariepinus* before and after feeding with 0%, 25%, 50%, 75% and 100% inclusion levels of Black Soldier Fly (BSF) prepupae meal, as alternative animal protein ingredient to replace fish meal, for twelve weeks in triplicates. The sampled fish were gutted and washed with clean water, drained and dried on wire gauze placed in fish drying cabinet using charcoal. No additive was added to the gutted catfish. Samples of dried fish were analysed for moisture content, crude protein, ether extract, crude fibre, ash and nitrogen free extract using the standard procedures of AOAC (2005).

Sensory evaluation of dried fish samples:
Sensory evaluation of the dried fish samples were carried out by 20-man panel of consumer analysts, staff of Kwara State University, Malete, Nigeria. About 2g of the dried experimental catfish was put in small polythene bag and blind coded to avoid bias. Each member was given the coded fish samples and evaluated the appearance, aroma, taste, texture and general acceptability of fish using a 7-point hedonic scale (7= Excellent, 6=Very good, 5=Good, 4=Fairly good, 3=Fair, 2=Poor, 1=Very poor). Value below 3 indicated that fish sample was not acceptable. Panel members were provided with portable water to rinse their mouths after tasting each fish sample so as to minimise carryover of taste to other samples.

Statistical analysis:
Data obtained were analysed using one way Analysis of Variance (ANOVA) while Duncan multiple range test was used to determine the level of significance among treatments at $p<0.05$, using SAS Windows 2010.

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Results and Discussion

Table 2 shows the proximate composition of dried *C gariepinus* fed varying inclusion levels of BSF prepupae meal in replacement of fish meal on a dry-weight basis. There were significant differences ($p<0.05$) in the moisture content, crude protein, ether extract, crude fibre, ash and nitrogen free extract of the dried fish before the commencement of the experiment and after the experiment. Crude protein of *C gariepinus* fed BSF prepupae meal was significantly ($p<0.05$) higher than that of the control diet containing only fish meal as animal protein while the ether extract increased significantly ($p<0.05$) from 25% - 100% inclusion level. Ash contents of the catfish fed experimental diets were significantly ($p<0.05$) higher than that of the fish before the experiment with the highest value obtained for the fish fed 100% inclusion level of BSF prepupae meal.

Table 2: Proximate composition of African catfish fed with BSFprepupae larvae in replacement of fish meal for 12 weeks

	BSF prepupae inclusion levels				
Contents	**0%**	**25%**	**50%**	**75%**	**100%**
Moisture	5.68^{b}	4.23^{c}	5.73^{a}	4.32^{d}	2.62^{f}
Crude protein	68.64^{f}	71.73^{d}	72.53^{c}	69.43^{e}	74.48^{a}
Ether extract	8.40^{d}	7.92^{f}	8.24^{e}	8.94^{b}	9.31^{a}
Crude fibre	0.12^{cd}	0.10^{d}	0.16^{b}	0.14^{cb}	0.20^{a}
Ash	10.88^{c}	10.02^{e}	11.31^{b}	10.81^{d}	11.77^{a}
Nitrogen free extract	6.77^{a}	5.53^{c}	2.04^{e}	6.37^{b}	1.63^{f}

Means having the same letter in the same row is not significantly different at $P< 0.05$.

Table 3: Sensory evaluation of African catfish fed diets containing varying levels of BSF diets.

Sensory qualities	**0%**	**25%**	**50%**	**75%**	**100%**
Appearance	6.05^{c}	6.05^{c}	6.25^{ab}	6.35^{a}	6.10^{bc}
Aroma	5.6^{a}	5.75^{a}	5.85^{a}	5.6^{a}	□□□^{a}
Taste	5.6^{a}	5.55^{a}	5.85^{a}	5.6^{a}	5.6^{a}
Texture	5.85^{ab}	5.85^{ab}	5.9^{a}	5.80^{ab}	5.85^{ab}
General acceptance	5.95^{a}	6.05^{a}	6.05^{a}	6.00^{a}	5.95^{a}

Means having the same letter in the same row is not significantly different at $P< 0.05$.

Increased inclusion level of BSF prepupae in the diet seemed to increase the crude protein, ether extract and ash contents in the fish. This might be attributed to high level of these nutritional components present in BSF prepupae meal and their digestibility by the fish. The higher ash contents obtained from fish fed 50% and 100% BSF meal might be an indication of mineral contents of the larvae. The crude protein of the control diet in this study was similar to the value for *C. gariepinus* (66.62 - 68.17) reported by Agbabiaka *et al.* (2012) while the values obtained for *C. gariepinus* fed BSF prepupae based diets were higher. Contrary to the significant effect on protein and ash content observed in this study, Sealy *et al.* (2011) reported no significant effects in muscle protein and ash content of rainbow trout fed BSF prepupae meal.

Table 3 showed the mean evaluation scores of 20 sensory-man panel on *C. gariepinus* fed BSF prepupae meal at varying inclusion levels. *C. gariepinus* fed BSF prepupae meal at 75% inclusion was ranked best in terms of appearance by consumer panellists. There were no significant differences ($p<0.05$) in the aroma, taste, texture and general acceptance among the fish fed BSF prepupae meal and the control diet. Generally, the scores for the sensory qualities range a from 5.6 to 6.35. The values indicate that the consumers rated the sensory qualities of the fish either good or very good.

Carl *et al.* (1993) similarly reported no significant difference among sensory qualities of Channel catfish fed Distillers' grains in replacement of soybean. The report in this study was also similar to Drobna *et al.* (2006), D'Sousa *et al.* (2006) and Sealy *et al.* (2011) who reported that no significant differences were noted by taste panel on the fillet quality of rainbow trout fed linseed and sunflower oil; soybean and BSF prepupae diet based meals respectively except for colour.

Conclusion

Inclusion of BSF prepupae meal in replacement of fish meal in the diet of African catfish, (*Clarias gariepinus)* did not reduce the nutritional and sensory qualities of the fish. Hence, BSF prepupae meal is recommended for aquaculture use. There is need for research into mass production of the larvae in African countries, especially in Nigeria.

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