

Growth performance and survival rates of Nile tilapia (*Oreochromis niloticus* L.) reared on diets containing Black soldier fly (*Hermetia illucens* L.) larvae meal

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INTRODUCTION

The global population is on the rise, and projections have shown that by 2050, approximately 9.7 billion people will be inhabiting the globe. Aquaculture continues to play a major role in providing high-quality protein for the global population. However, the industry's success is highly dependent on high protein feeds which make up to 60-70% of the farm's operational costs. Fish meal (FM) has been an important source of protein but its sustainability has been questioned following the overexploitation, that has further contributed to its high prices. This has prompted research on potential FM replacers amongst them the black soldier fly (BSF) larvae (*Hermetia illucens*).

OBJECTIVES

- ✓ To assess the nutritive value of black soldier fly larvae meal and the growth performance and survival rates of Nile tilapia (*Oreochromis niloticus*) fed on this alternative source of protein in Kenya.



RESULTS & DISCUSSION

Water quality parameters

- Significant differences ($p < 0.05$) in the analyzed physico-chemical parameters. However the values were within the recommended ranges for the culture of Nile tilapia.

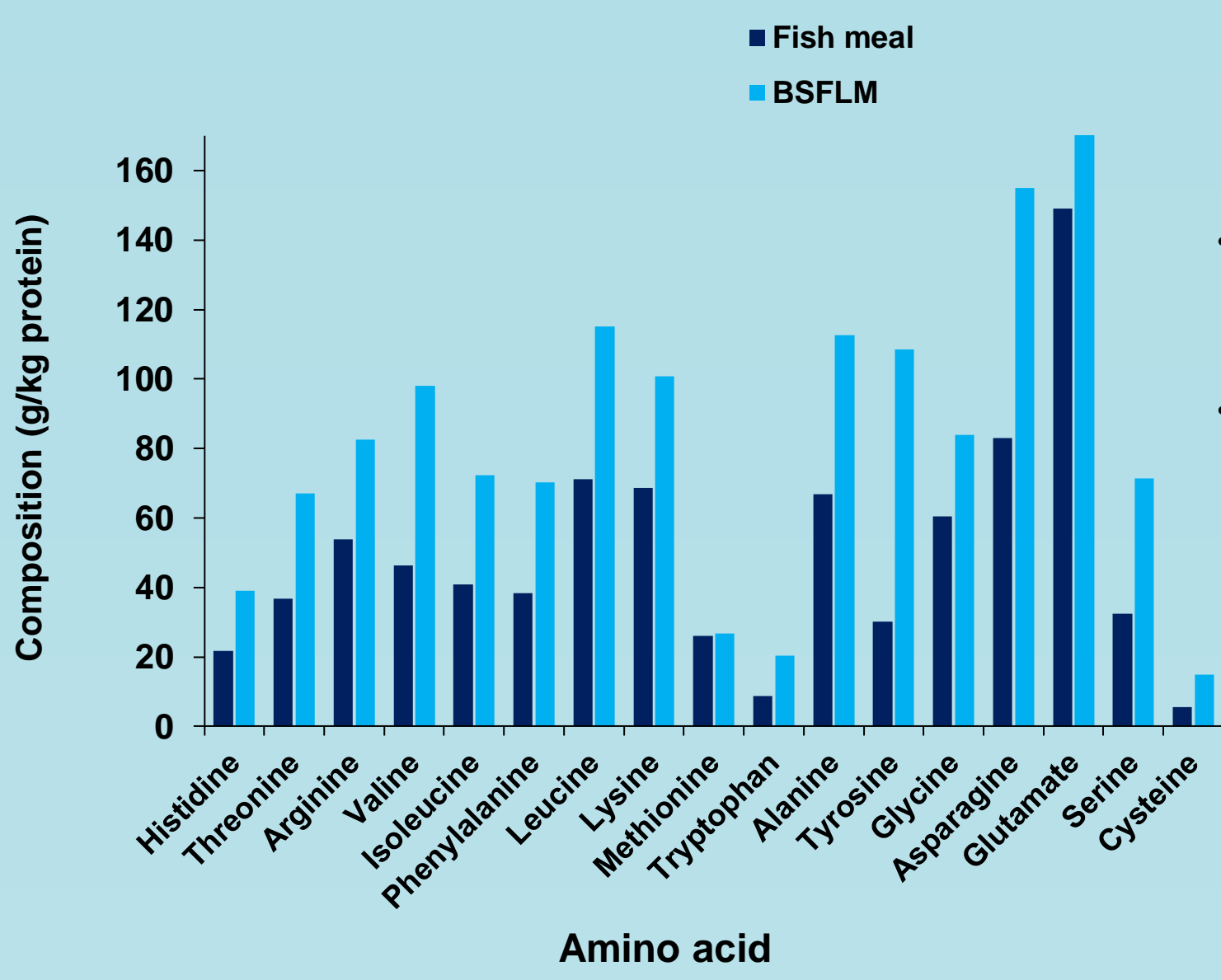
Parameter	Unit	Mean	Min	Max
Temperature	(°C)	25.8 ± 1.1	23.5	27.8
DO	(mg/L)	6.8 ± 0.5	5.9	8.2
Conductivity	(µS/cm)	71.6 ± 16.9	51.1	102.6
TDS	(mg/L)	45.8 ± 9.8	33.8	63.1
Salinity	(mg/L)	0.03 ± 0.01	0.02	0.05
pH			7.4	9.0
PO ₄	(mg/L)	0.002 ± 0.0004	0.002	0.003
NO ₂	(mg/L)	0.001 ± 0.0002	0	0.001
NO ₃	(mg/L)	0.001 ± 0.0002	0.001	0.002
NH ₄	(mg/L)	0.01 ± 0.001	0.01	0.01

In Kenya the cost of BSF larvae ranges from 0.6 to 1.2 USD/kg while fish meal is from 1.2 to 1.5 USD/kg and freshwater shrimp is from 0.9 to 1.6 USD/kg. These low costs of BSF larvae are associated with the low cost of feeding them (they feed on low value organic wastes) and the simplicity of the culture systems used.

Cost of ingredients used in formulating the test diets. * 1 USD = 100 Kes.

Ingredient	Price (Kes) per kg
Fish meal	*140
Freshwater shrimp	100
Black soldier fly larvae	*80
Cotton seed cake	40
Sunflower seed cake	40
Maize germ	28

Amino acids composition in FM and BSF larvae meal

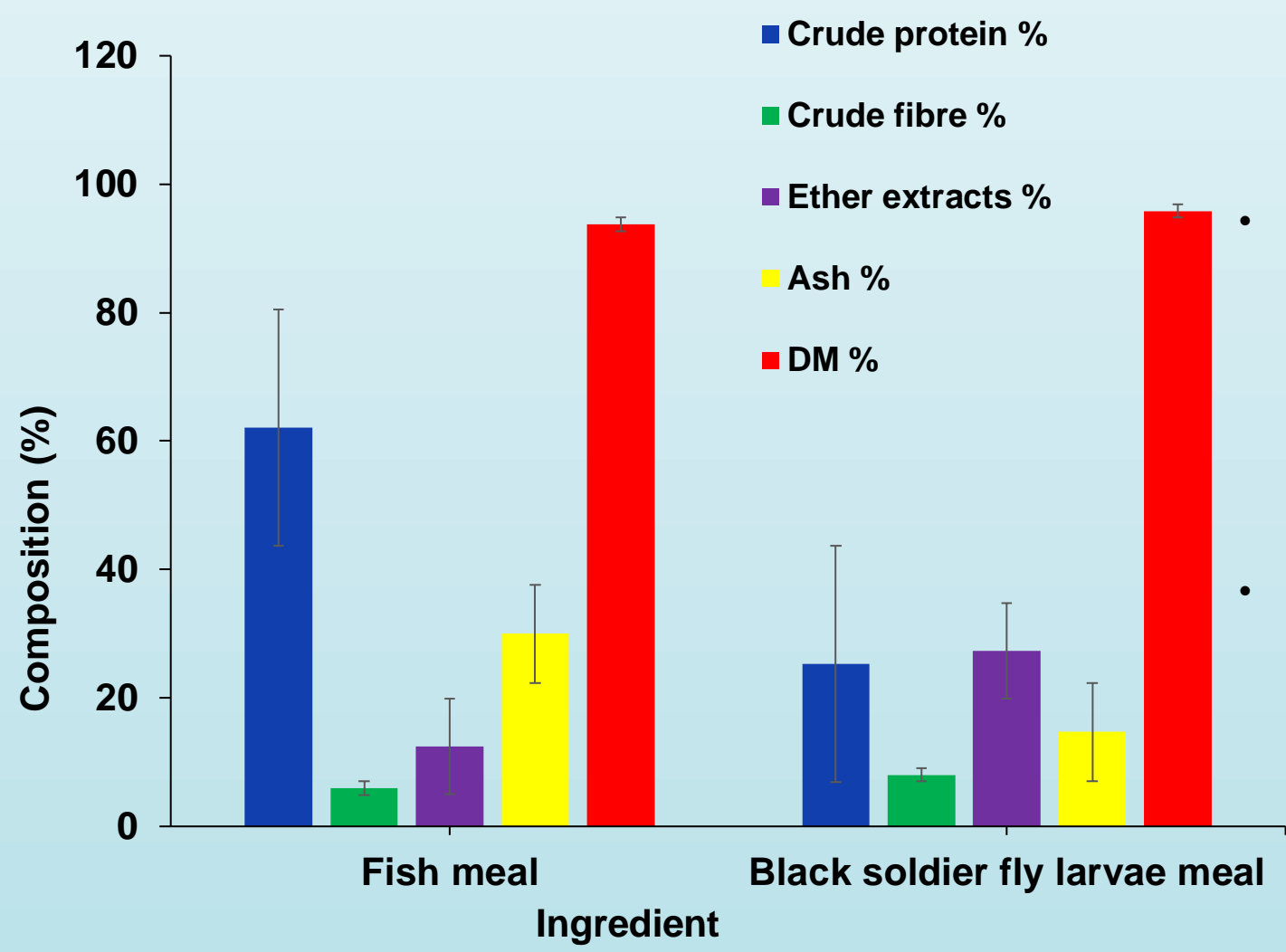


- FM and BSFLM have similar profiles of AA (contains all the 10 essential amino acids).
- The BSFLM protein (g/kg protein) recorded higher composition of amino acids than fish meal protein an indication of the high quality of protein in BSFLM

MATERIALS & METHODS

The feeding trial was conducted from October 2019 to January 2020 at Sagana fish farm (0o19' S and 37o12' E) of the Kenya Marine and Fisheries Research Institute (KMFRRI) to assess the effects on growth performance and survival rates of Nile tilapia when FM was replaced with different proportions of black soldier fly larvae meal (BSFLM) in the formulated diets. Four diets were formulated with substitutions of FM by BSFLM made at 0%, 33%, 67% and 100%. 240 male Nile tilapia (52.3 ± 0.29g mean weight) were divided into 4 groups (4 replicates/group) and placed in 16 hapa nets (15 fish/hapa), mounted in an 800m² earthen pond. Fish were fed twice per day at 5% of body weight at 1000 and 1600hrs. Fish sampling took place every two weeks; mortalities were recorded daily while the physico-chemical parameters were monitored weekly at 10:00 hrs .

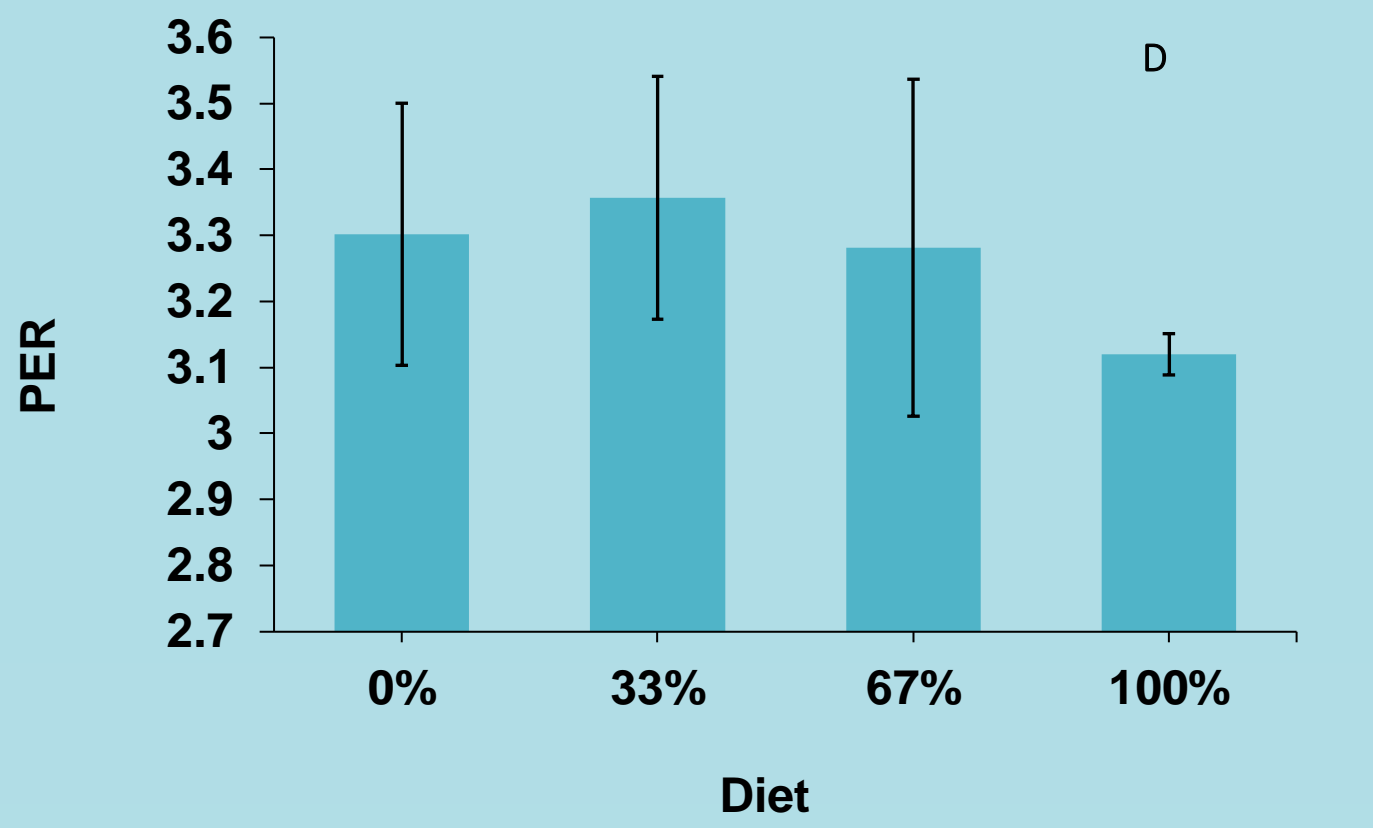
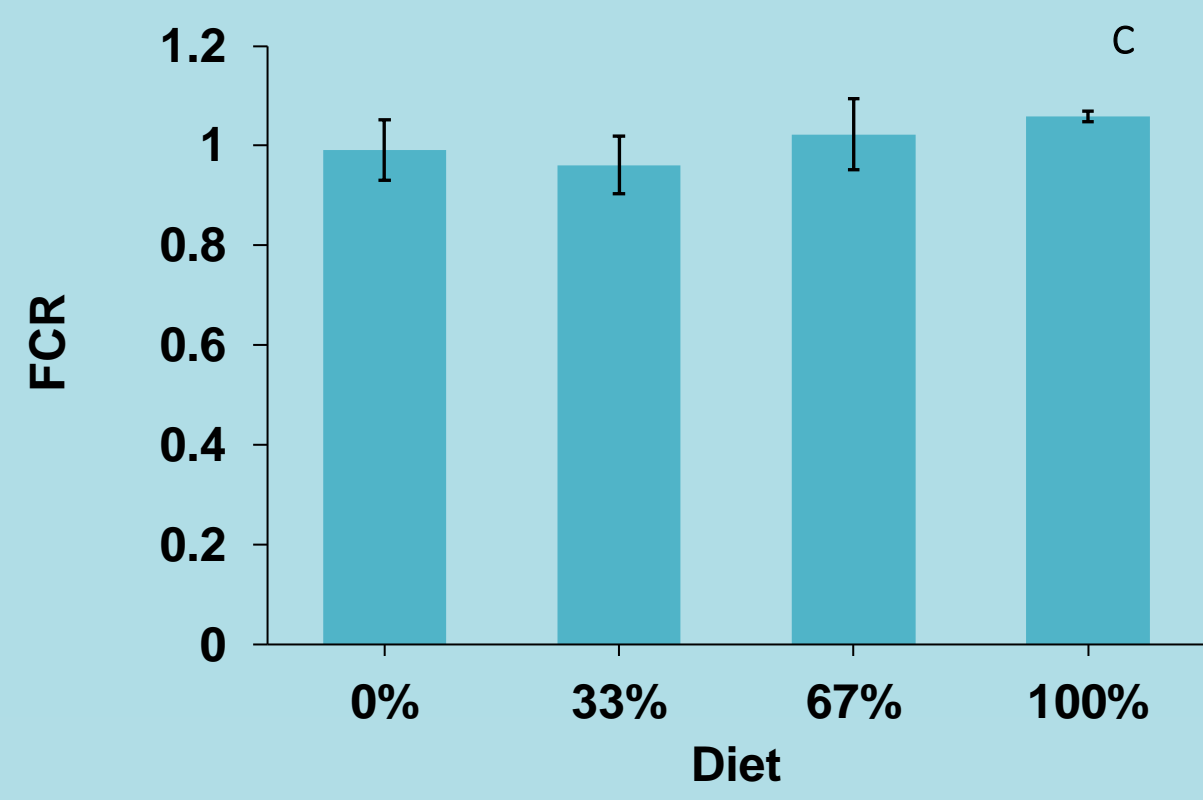
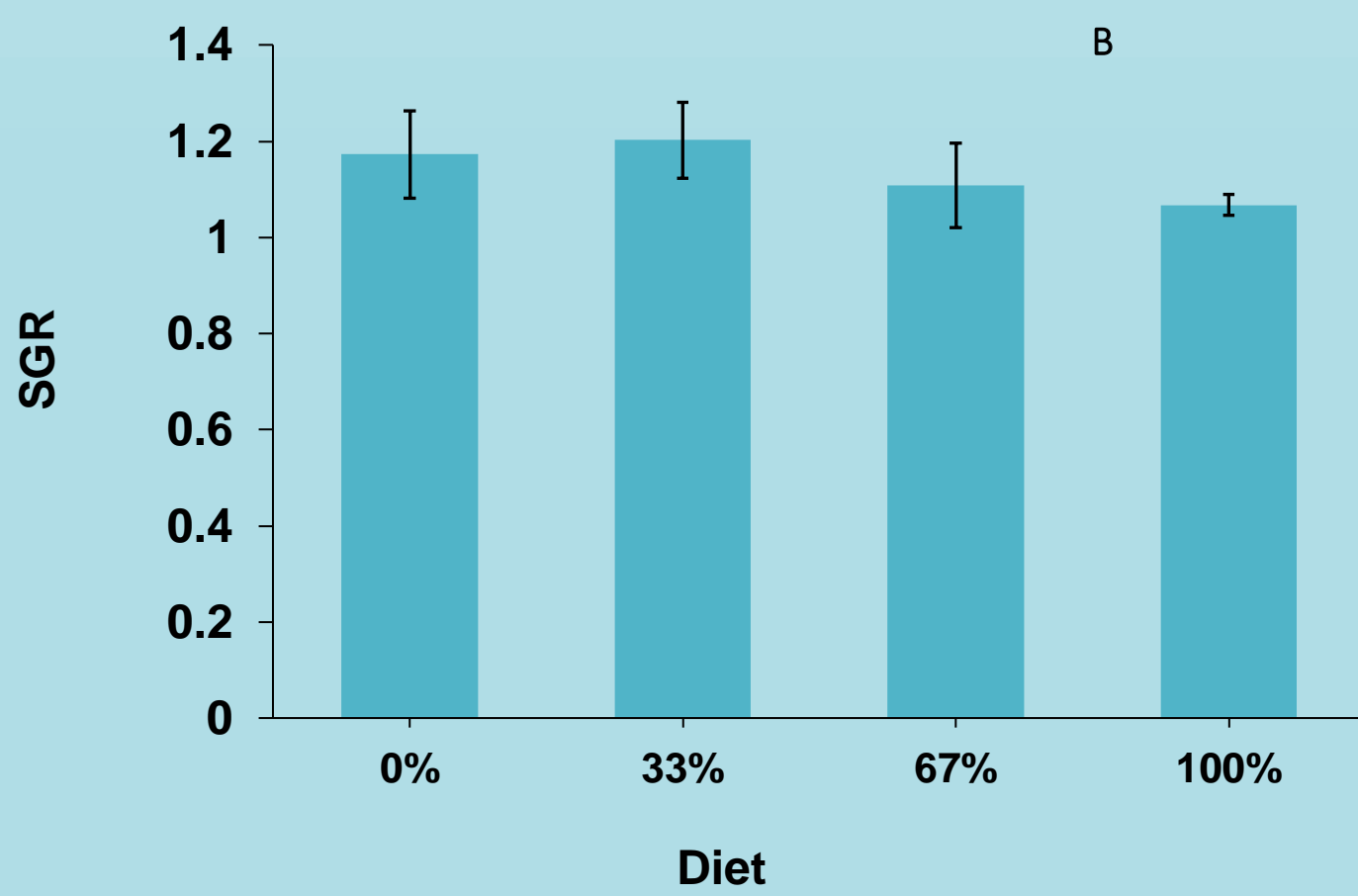
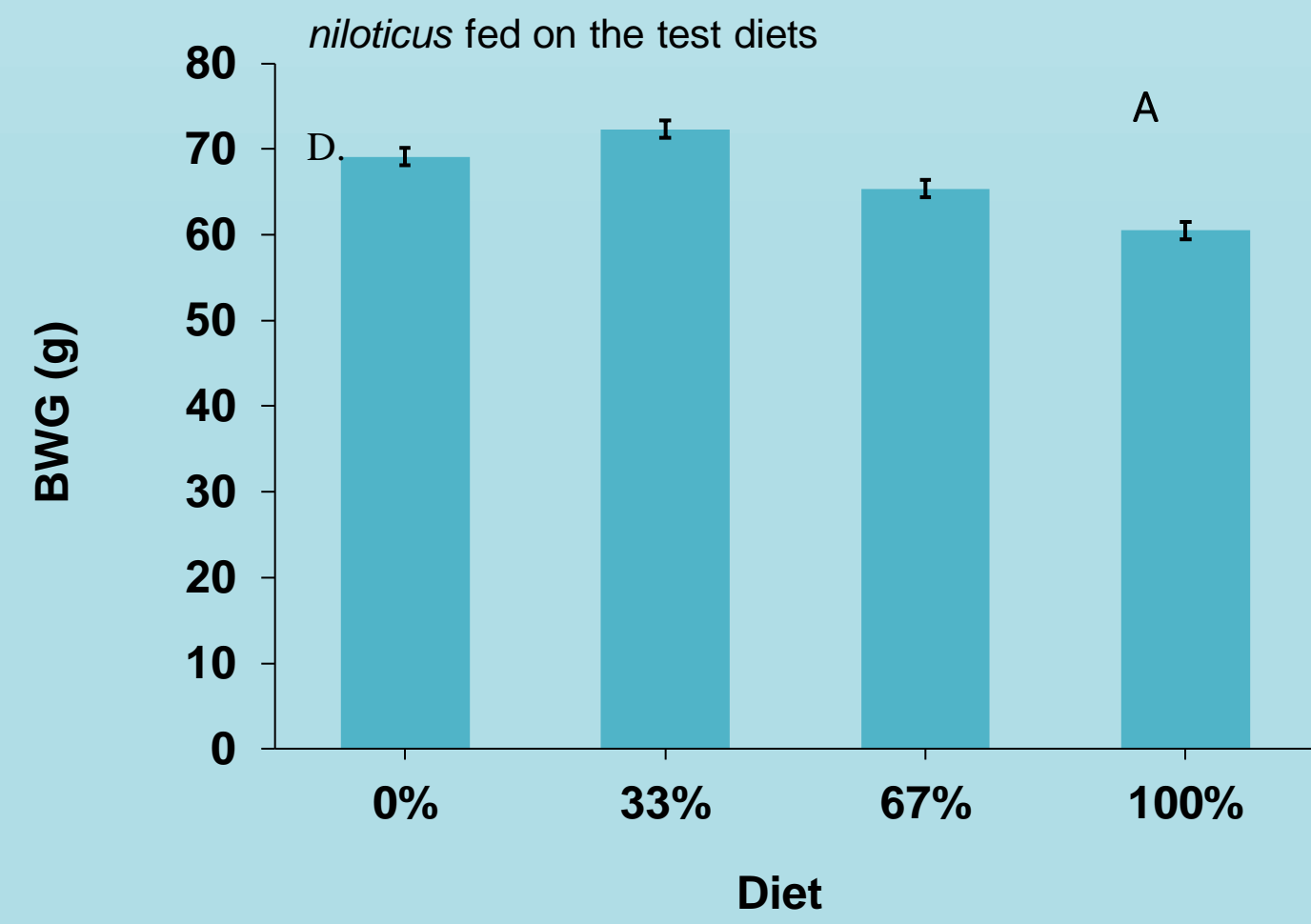
Proximate analysis of fish meal and BSFLM



- Fish that were fed on diet 2 recorded highest numerical values in the survival rates, body weight gain, specific growth rate and the lowest feed conversion ratio however, no significant differences ($p > 0.05$) were reported between the diets.

- Although black soldier fly larvae meal has lower contents of crude protein and higher ether extracts, in comparison to fish meal, the larvae has been found to have high quality protein.

A. Body weight gain (g) , B. Specific growth rate (%), C. Feed conversion ratio and D. Protein efficiency ratio of *O. niloticus* fed on the test diets



CONCLUSION

- The production of BSF larvae is widespread in Kenya and prices are lower than those of FM hence BSFLM can be a cost effective replacement for FM.
- The present study indicates that full fat BSFLM can replace up to 100% of the FM without negative effects on the growth performance and survival rates of Nile tilapia, although the slight trend towards reduced growth for the 100% substitution diet points at the need for future studies on increasing the nutritional value of BSFLM e.g., by further processing.