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LENGTH-WEIGHT RELATIONSHIP OF *CLARIAS GARIEPINUS* FED *PSIDIUM GUAJAVA* AND *MANGIFERA INDICA* LEAF EXTRACT

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ABSTRACT

The length weight relationship (LWR) of Clarias gariepinus fed Psidium guajava and Mangifera indica leaf extract was evaluated for six (6) months. A total of 420, eight (8) weeks old fingerlings of Clarias gariepinus was used for this study. Experimental fish were fed 40 % crude protein diet with inclusion of both leaf extracts at 0 %, 4 %, 6 %, and 8 %. Experimental fish were stocked in twenty-one 4ft by 4ft tarpaulin tanks half filled with borehole water, acclimation was done for 7 days during which they were fed commercial diet. Aqueous extract was done for both leaves and stored in plastic cans for further use. Weight and length of fish was measured biweekly and data was used to assess the length-weight relationship. The result of this study showed that the best weight was recorded in treatment 2 fed 4 % Psidium guajava extract and the least in treatment 5 fed 4 % Mangifera indica extract. The result on LWR revealed the regression coefficient 'b' to be from 17.68-20.40 which indicates a positive allometric growth, since 'b' value is more than 3. This further means that the fish samples in this study became heavier, stouter, deeper bodied or bigger as it increases in length i.e all parts of the fish increase in size proportionately with the length.

Keywords: Length weight relationship, Feeding, Allometric growth

INTRODUCTION

Fish is an aquatic animal that has scales on its body and fins, both paired and unpaired fins. Feeding in fish culture is the most essential factor that must be taken into consideration. Fish like other animals have a requirement for essential nutrients in order to grow properly and reproduce (Olele, Onyema, and Odiko, 2013). Length-weight relationship (LWR) is of great importance in fishery science and stock assessment/management and widely recognized. Length and weight measurements of fish in concurrence with data on fish age can give information on the fish stock, age maturity, life span, mortality, growth and reproduction (Kumar et al., 2022). Been that length-weight relationship permits the estimation of weight of fish easily when the total length is known, these relationships are useful when rapid estimation of biomass is necessary (Froese, 1998). Fish exhibits isometric, positive and negative allometric growth pattern. When length increases in equal proportion with body weight, it is termed isometric growth pattern, and the regression coefficient for isometric growth is b equal to '3'. Negative allometric growth pattern indicates that the fish becomes slender as length increase (<3) while and values greater than '3' indicates positive allometric growth (Olurin and Aderibigbe, 2006). This study was carried out to assess the growth performance using length and weight as parameters of *Clarias gariepinus* fed *Psidium guajava* and *Mangifera indica* leaf extract.

MATERIALS AND METHODS

Study area

This study was done in the Department of Fisheries and Aquaculture, Delta State University, Abraka. Abraka which is in the South-South zone of Nigeria

Duration of study

This study lasted 6 months during which fish samples were fed to satiation, with experimental diet.

Collection of samples

A total of four hundred and twenty, of pure hatchery bred *Clarias gariepinus* (8 weeks old) with average weight and length of 12.4 g and 9.0 cm respectively was used for the purpose of this study. Fish samples were purchased from Rex Agro farms, Asaba, Delta state and transported in 50 liters cut out plastic jerican to the project site at DELSU, Abraka. Acclimation was done for 7 days during which fish samples were fed 2 mm aller aqua fish feed (commercial diet).

Experimental diet

Experimental diet with 40 % crude protein was formulated for this study with the use of pearson's square method (Lukram, 2020). *Psidium guajava* and *mangifera indica* leaf extracts were included at these levels- 0 %, 4 %, 6%, 8% each, mixed thoroughly with other ground and measured ingredients and extruded with an extruding machine to produce floating feed for the fish.

Fish feeds were extruded as the fish grows from 2 mm to 6 mm and these were sun-dried, packed in 50kg sack bags and labelled, T1 (0 %), T2 (Guava 4 %), T3 (Guava 6 %), T4 (Guava 8 %), T5 (Mango 4 %), T6 (Mango 6 %), T7 (Mango 8 %) and stored in a cool and dry place.

Table 1: Feed formulation (100 g) of *Psidium guajava* and *Mangifera indica* at various inclusion levels

	CONTROL		*Psidium guajava*			*Mangifera indica*	
Ingredients	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**
Fish Meal	33.93	33.93	33.93	33.93	33.93	33.93	33.93
GNC	16.97	16.97	16.97	16.97	16.97	16.97	16.97
Yellow Maize	31.10	31.10	31.10	31.10	31.10	31.10	31.10
Vitamin Premix	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Palm Oil	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Salt	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Starch	7.55	7.55	7.55	7.55	7.55	7.55	7.55
BHT/BHA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Chromic Trioxide	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	100	**100**	**100**	**100**	**100**	**100**	**100**
Psidium Guajava	0	4.0	6.0	8.0	0	0	0
Mangifera Indica	0	0	0	0	4.0	6.0	8.0

KEY:
PGLE- *Psidium guajava* leaf extract
MILE- *Mangifera indica* leaf extract
T1-T7- Treatment 1-7
GNC- Groundnut cake
BHT/BHA- Butylated hydroxytoluene/butylated hydroxyanisole

Experimental design
A complete randomized block design (CRDB) where fish samples were randomly distributed in twenties into 21 tarpaulin tanks, measuring 4ft by 4ft each, half filled with clean borehole water which was half renewed biweekly was used. These tarpaulin tanks were treated using poultry droppings before stocking. The tanks were distributed in threes to form 7 treatments in triplicates labeled $T1_{A-C}$, $T2_{A-C}$, $T3_{A-C}$, $T4_{A-C}$, $T5_{A-C}$, $T6_{A-C}$ and $T7_{A-C}$, where T1 was the control diet, T2 –T4 was fed 4 %, 6 %, 8 % *Psidium guajava* and T5 –T7 was fed 4 %, 6 %, 8 % of *Mangifera indica*. Pond water was half renewed by reducing the water halfway and topping up biweekly.

Data collection and statistical analysis
Weight and length of fish cultured fish samples were measured biweekly. The weight of fish was measured with a measuring scale and total length measured from the tip of the snout to the tail fin using a calibrated meter rule. Data from weight and length measurement was subjected to ANOVA using SPSS version 20. The length-weight relationship of fish samples were calculated using the equation below:

$W = aL^b$
Where; W= Weight of fish in g
L=Length of fish in cm
a= Constant value
b= an exponent
The values of constant a and b were calculated using least square linear regression to give
log W= loga + bLog L. Rickter (1973)

RESULTS AND DISCUSSION
The effect of *Psidium guajava* and *Mangifera indica* on mean weight of *Clarias gariepinus* is shown in table 2. Body weight was significantly different amongst the treatments at $P<0.05$. The highest mean body weight was recorded in T2 (4 % PG) as $441.41g\pm10.48^a$, which was higher than other treatments. This was followed by T4 (8 % PG) with mean body weight of $412.74g\pm9.87^b$ which was not significantly different from mean body weight recorded in T3 (6 % PG) as $409.84g\pm9.53^b$. The least mean body weight was recorded in T5 (4 % MI) as $376.15g\pm9.19^c$ and this was not significantly different from T1, T6, and T7 which had $393.43g\pm9.75^c$, $383.99g\pm8.76^c$, $389.92g\pm9.62^c$ respectively.

Table 2: ANOVA for the variation in body weight with experimental diets

			PGLE			MILE	
Parameters	**T1 (0%)**	**T2 (PG 4%)**	**T3 (PG 6%)**	**T4 (PG 8%)**	**T5 (MI 4%)**	**T6 (MI 6%)**	**T7 (MI 8%)**
Body weight(g)	393.43 ± 9.75^c	441.47 ± 10.48^a	409.84 ± 9.53^b	412.74 ± 9.87^b	376.15 ± 9.19^c	383.99 ± 8.76^c	389.92 ± 9.62^c
Standard length(cm)	26.49 ± 0.32^b	27.09 ± 0.38^b	33.61 ± 4.35^a	26.05 ± 0.38^b	24.95 ± 0.37^b	25.58 ± 0.37^b	25.39 ± 0.38^b
Total length(cm)	31.19 ± 0.55^a	31.18 ± 0.42^a	30.09 ± 0.41^b	30.03 ± 0.41^b	29.12 ± 0.40^b	32.46 ± 2.71^a	29.39 ± 0.41^b

Means with same superscripts on the vertical row are not significantly different (P<0.05) ± standard error of mean

The length-weight relationship of this study presented in figures 1-8 revealed a strong positive correlation between length and weight with coefficient of Determination (R^2) value less than 1 for all treatments and a positive allometric growth pattern for each treatment and for all treatments as the weight of the fish increased in proportion to its length as indicated by the slope (b) value which was greater than 3. In other words, fish samples in this study became stouter or deeper bodied as it increases in length. From the graphs, the coefficient of determination (R^2) expresses the relationship between the length and weight of fish, also the value of R^2 is greater than 0.5 and less than 1 ($R^2 > 0.5 < 1$). Also a summary of the length weight relationship (LWR) is presented in table 2 showing the regression coefficient and correlation coefficient,

Length-weight Relationship
The length weight relationship revealed a positive allometric growth pattern for each treatment and for all treatments as presented in Figure 1 – 8 TL is (Total length and WT is weight).

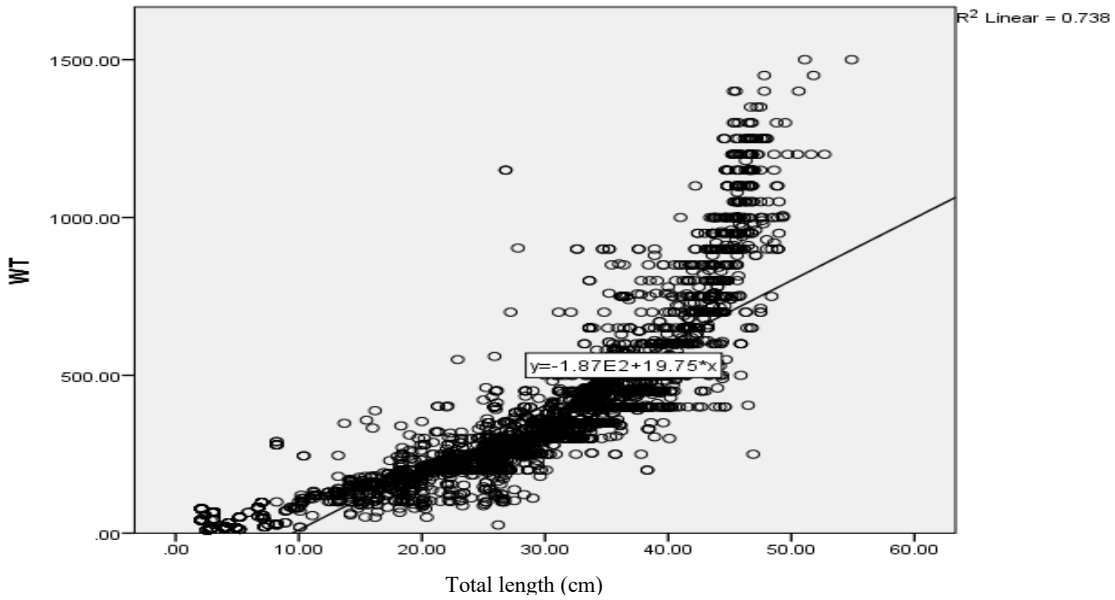

Figure 1: Relationship between body weight and total length for all treatments

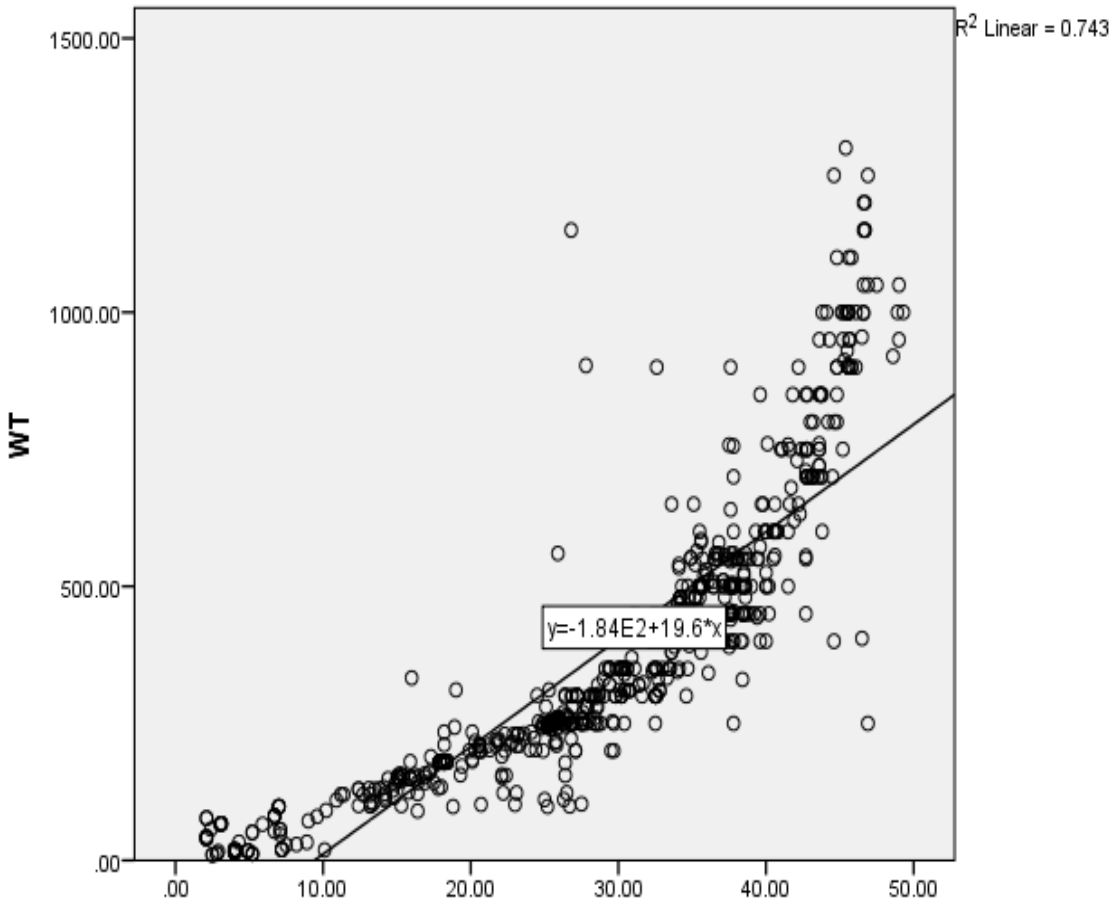

Figure 2: Relationship between body weight and total length for treatment 1(control)

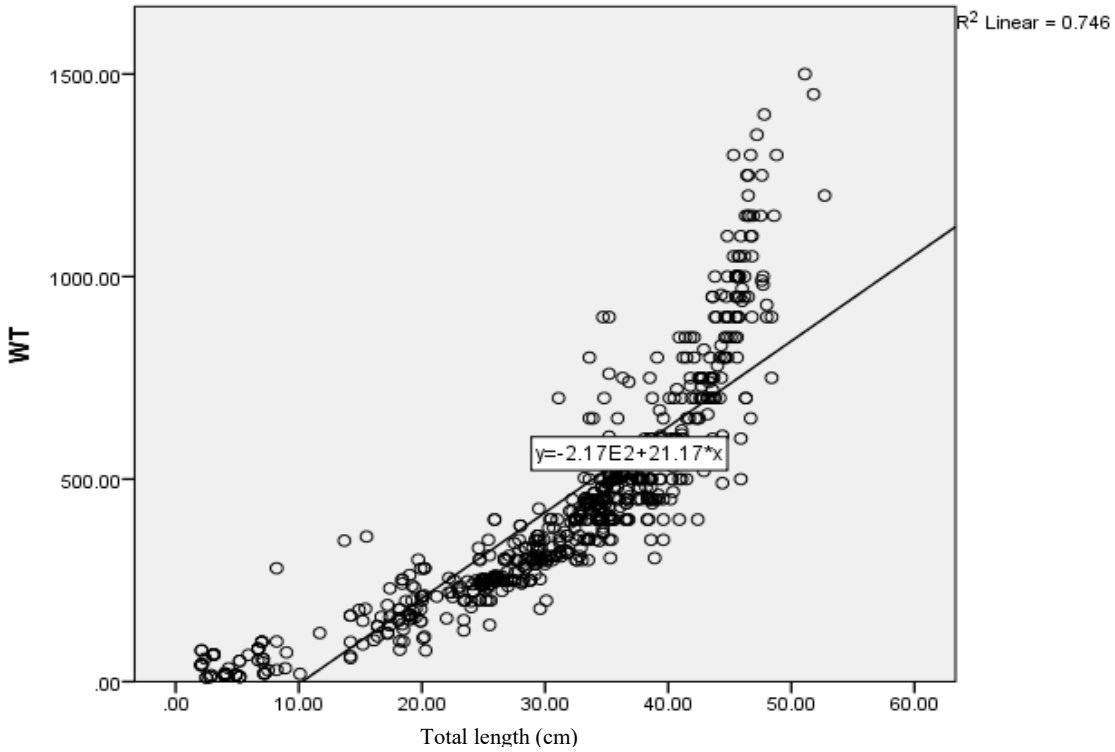

Figure 3: Relationship between body weight and total length for treatment 2 (4 % PG)

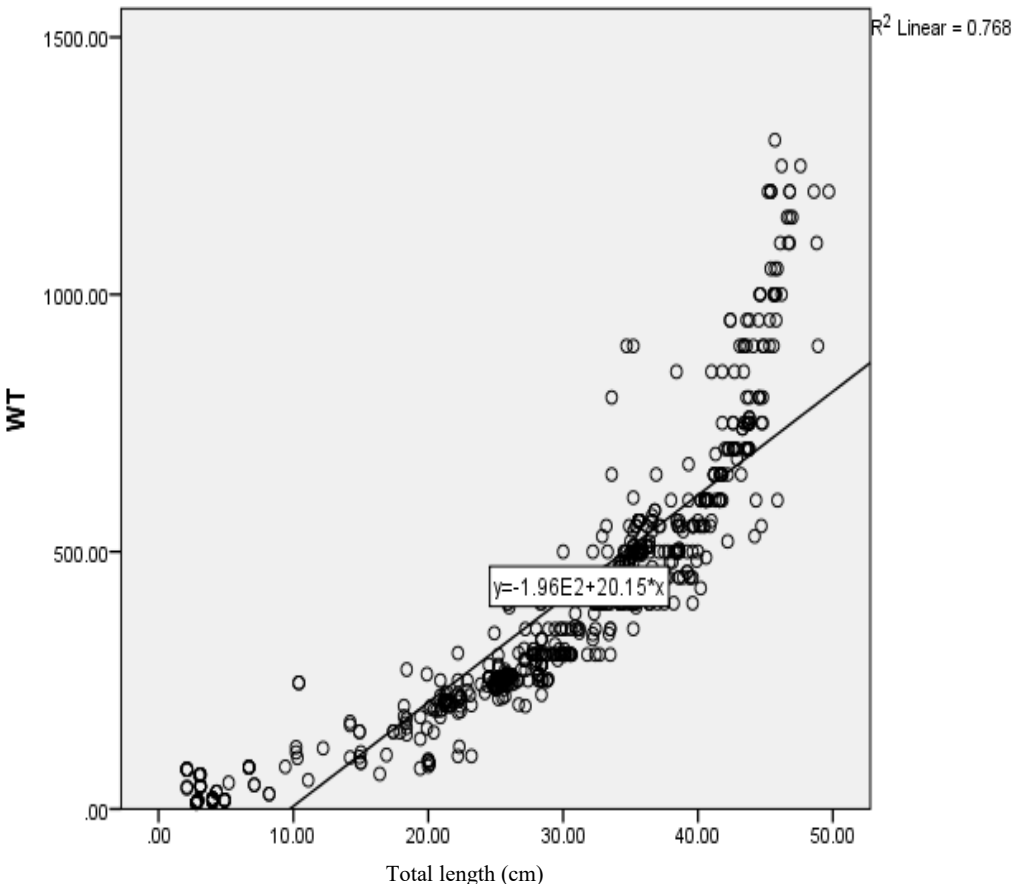

Figure 4: (Relationship between body weight and total length for treatment 3 (6 % PG)

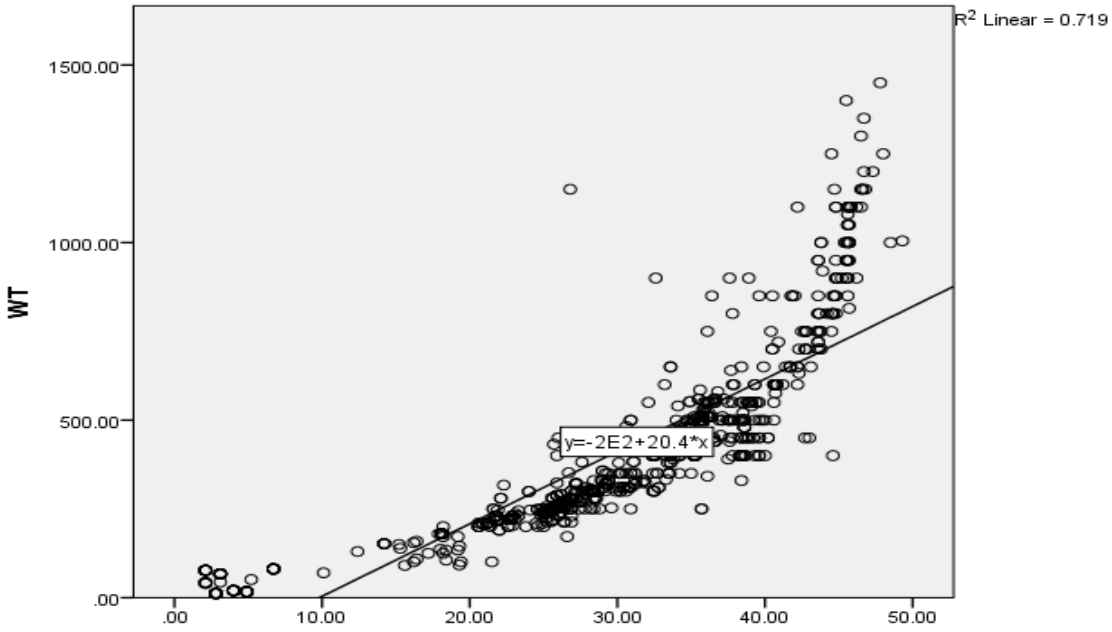

Figure 5: Relationship between body weight and total length for treatment 4 (8 % PG)

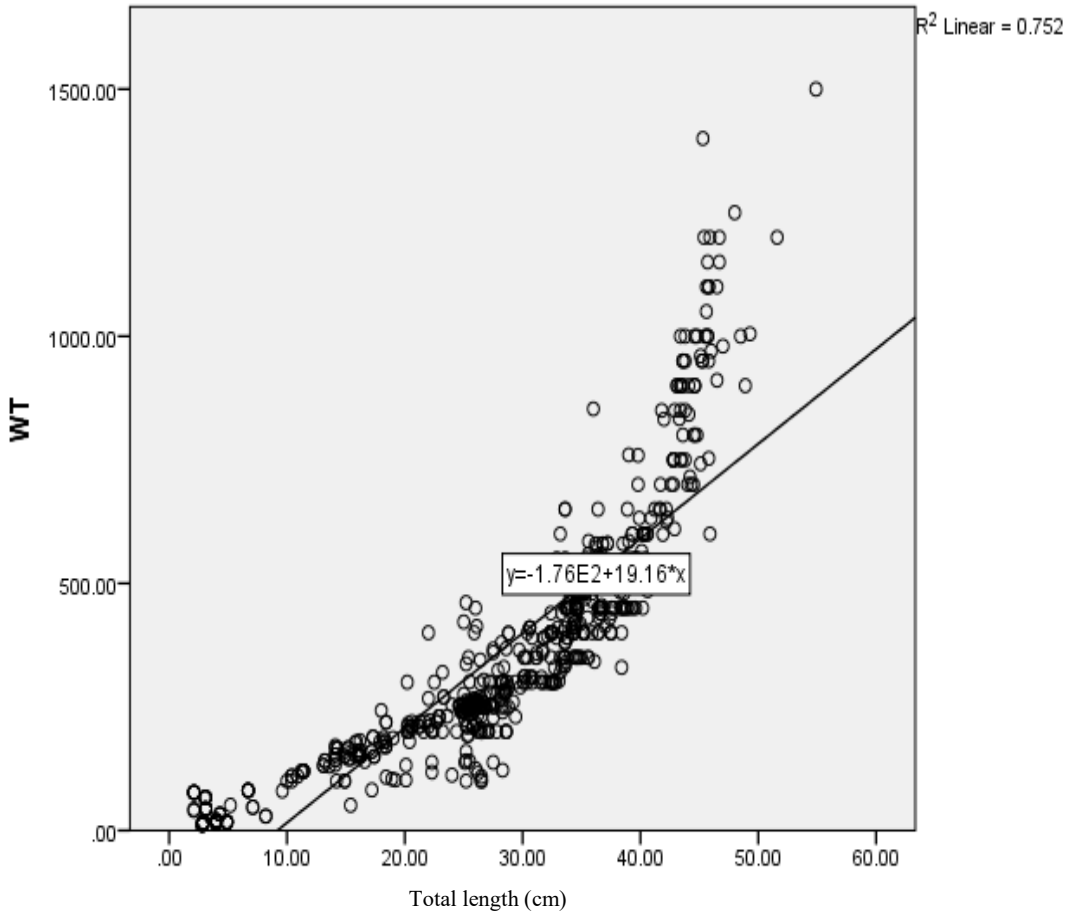

Figure 6: Relationship between body weight and total length for treatment 5 (4 % MI)

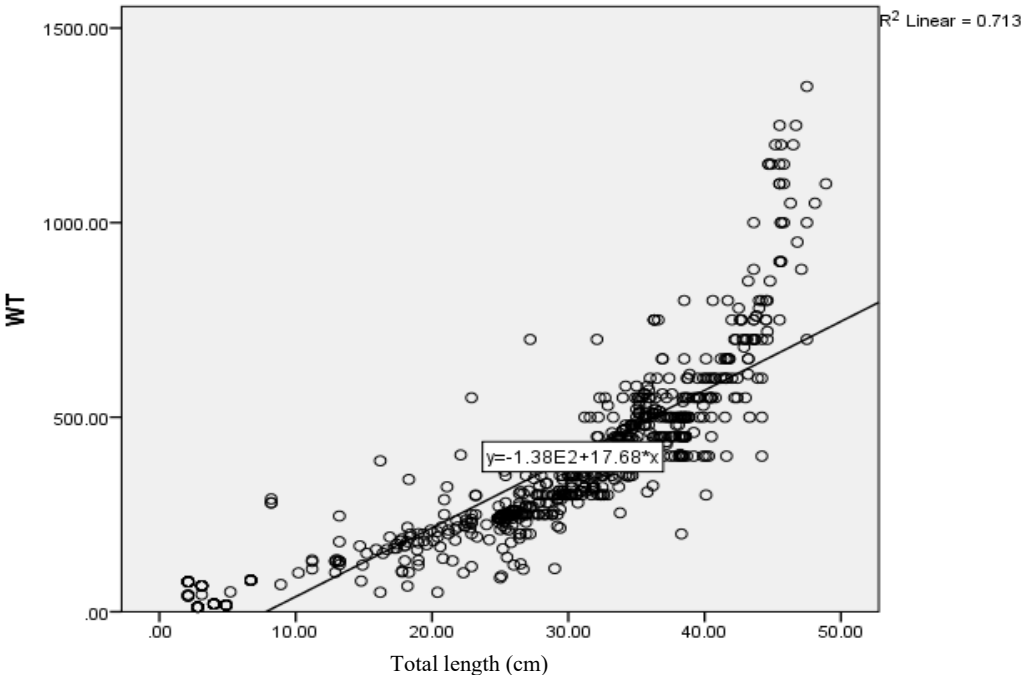

Figure 7: Relationship between body weight and total length for treatment 6 (6 % MI)

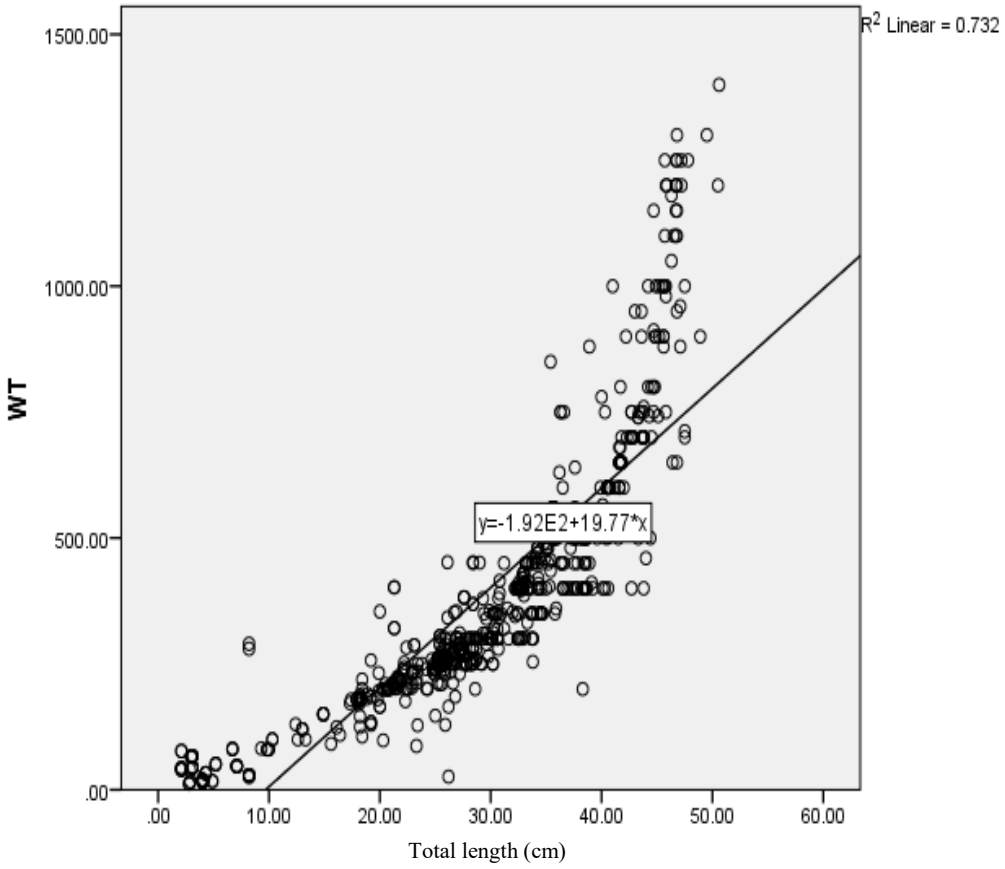

Figure 8: Relationship between body weight and total length for treatment 7 (8 % MI)

Summary of the length weight relationship (LWR)

The length-weight relationship of body weight and total length of fish samples for all treatments and each treatment (1-7) is presented in table 2. The correlation coefficient (r^2) value is displayed in the second column ranging from of 0.713-0.768. The regression coefficient 'b' ranges from 17.68-20.40 which indicates a positive allometric growth, since 'b' value is more than 3. This means that all the fish in this study became heavier, stouter, deeper bodied or bigger as it increases in length i.e all parts of the fish increase in size proportionately with the length.

Table 2: Summary of the length weight relationship (LWR)

Treatments	B	r^2
All treatments	19.75	0.738
T1 (0%)	19.60	0.743
T2 (PG 4%)	21.17	0.746
T3 (PG 6%)	20.15	0.768
T4 (PG 8%)	20.40	0.719
T5 (MI 4%)	19.16	0.752
T6 (MI 6%)	17.68	0.713
T7 (MI 8%)	19.77	0.732

Discussion

Clarias gariepinus fed *Psidium guajava* and *Mangifera indica* shows the highest body weight to be Treatment 2 (4 % PG)- 441.41g and the least mean body weight was recorded in Treatment 5 (4 % MI)- 376.15g. This means that *Psidium guajava* leaf extract performed better than the leaf extract of *Mangifera indica.* This study however, disagrees with that of Jannatul *et al*., (2017) who reported that tilapia fish fed 8 % *P. guajava* leaf extracts showed better growth rate compared to 2 %, 4 %, and 6 %. This may be because of the different fish species been studied. *P. guajava* tree has a long history of medicinal uses that are still employed today. *P. guajava* is known for their anti bacterial, immune boosting characteristic which was also reported by Jannatul *et al*., (2017) who stated that it acts as immunostimulant, reduce mortality and disease resistance in *O. niloticus* against *P. fluorescens.* This present study aligns with the study of Omitoyin *et al*., (2019) who reported increased body weight of *Oreochromis niloticus* fed *Psidium guajava* though at 1 % inclusion. This present study also disagrees with Setufe *et al*., (2018) who reported reduced growth performance of cultured juvenile *Clarias gariepinus* fed *Psidium guajava* leaf meal at 40g/1kg. Adejonwo *et al*., (2020) reported the best weight gain at 3 % and the least at control diet with 0 % of *Pleurotus pulmonarius* stalk meal inclusion.

This present study revealed that fish fed with leaf extract performed better than the fish fed with no leaf extract which could be as a result of the growth stimulant present in the leaf extract as reported by Olusola and Olurunfemi (2018). Also the phytochemicals present in the leaf could also be a contributing factor to improving the nutrient absorption and digestion of feed by the fish which results in corresponding increase in fish weight. The studies of Narayanan *et al.,* (2016) and Adithepchaican, Parichat, and Pongsak (2008) agrees with this present study stating that guava leaf extract can be used as a promising feed additive in aquaculture. The use of medicinal plants as natural growth promoters have been proven to significantly improve weight gain, survival and feed conversion rates in fish by about 50 % (Afe *et al*., 2019).

The length-weight relationship of fish can be either isometric or allometric, and there's positive and negative allometric growth pattern. It is an important parameter that helps to know the pattern of growth of a fish population (Kumar, Kailasam, Sundaray and Ghoshal, 2022). When the regression coefficient 'b' value is equal to 3 (b=3) the growth pattern is said to be isometric resulting in no change of body shape as the fish grows but when the regression coefficient is not equal to 3 (b≠3), it is referred to as allometric growth pattern which can either be positive (b>3, fish becomes stouter or deeper bodied as it increases in length) or negative (b<3, fish becomes slender as it increases in weight) (Getso, Abdullahi and Yola, 2017).

The length-weight relationship of this study revealed a strong positive correlation between length and weight with coefficient of Determination (R^2) value less than 1. This result aligns with the study of Omodu, Solomon and Wilfred-Ekprikpo (2017) who reported allometric growth pattern of *Clarias gariepinus* fed formulated diet. A similar study by Shittu and Oguntoye (2020) reported a negative allometric growth pattern for *Clarias gariepinus* fish as the b value was less than 3 meaning the fish became slender as it increases in length. A study by Keyombe, Waithaka, and Obegi (2020) reported a positive allometric growth pattern also for same fish specie which agrees to that reported in this study (positive allometic growth pattern). The growth of fish depends on a lot of positive and negative factors; these disparities may be due to the different locations of the experiments or the type and composition of feed used. Another study by Ayo-Olalusi, (2014) revealed a positive allometric growth pattern with b value more than 3, this conforms to the present study. A negative allometric growth was also reported by Ameh, Makpo, and Cheka (2020) as the b value was less than 3. The work of Okwodu, Okoriea and Nwoke (2022) who reported a positive allometric growth pattern for cat fish with b value greater than 3 also agrees with the findings in this present study. Length-weight relationship is an important fishery management tool used for growth studies comparism and to determine the general well being of the fish.

CONCLUSION

This study on *Clarias gariepinus* has shown that *Psidium guajava* and *Mangifera indica* leaf extracts inclusion in fish diet have no negative impact on the length-weight relationship as results recorded, revealed a positive allometric growth pattern for each treatment. Fish increased in size proportionately with the length.

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