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# FEED UTILIZATION OF TILAPIA *Oreochromis mossambicus* UNDER DIETARY INCLUSION OF SWEET POTATO *Ipomoea batatas* AND WATERMELON *Citrullus lanatus* PEELS

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## Abstract

This study was carried out to investigate the feed utilization of tilapia *Oreochromis mossambicus* under dietary inclusion of dried sweet potato peels (DSPP) I*pomoea batatas* and dried watermelon peels (DWP) *Citrullus lanatus*. Four feed samples were formulated; T1, T2, T3 and Control such that T1 was formulated by including DSPP in normal fish feed, T2 was formulated by including DWP, T3 was formulated by including both DSPP and DWP while Control is the normal fish feed. Seventy-two (72) mixed sex tilapia fish fingerlings of average weight $10.72 \pm 0.43g$ were grouped into four with eighteen (18) fingerlings per group and further separated into three replicas of (6) fingering per replica fed with the four feed samples. The fishes were fed twice daily with feed of 5% their body weight and the feed utilization indicators considered were feed conversion ratio and feed conversion efficiency. The results of feed conversion ratio revealed that fish samples fed with the control feed sample had the best and significant feed conversion ratio ($0.87^{a}$) followed by fish samples fed with T3 feed sample ($1.18^{c}$) while those fed with T1 feed sample showed the lowest and significant feed conversion ratio ($1.43^{b}$). Also results on feed conversion efficiency showed that fish samples fed with the control feed sample had the best and significant feed conversion efficiency ($116^{a}$) followed by fish samples fed with T3 feed sample ($85^{c}$) while those fed with T1 feed sample showed the lowest and significant feed conversion efficiency ($70^{b}$). it was concluded that using both dried water-melon peel and dried sweet potatoes peel as inclusion in formulation of fish feed for tilapia will provide significantly improve on their feed utilization compare to using only dried water-melon peel or dried sweet potatoes. However, the feed sample without inclusion of both dried water-melon peel and dried sweet potatoes peel is still be best in improving the nutrient and feed utilization of the fish samples based on both feed conversion ratio and feed conversion efficiency

## Keywords:

Feed Utilization, *Tilapia Oreochromis mossambicus Dietary inclusion, Sweet Potato Peels Ipomoea batatas and Watermelon peels Citrullus lanatu.*

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## 1. INTRODUCTION

Fish farming, both intensive, semi-intensive or extensive, requires the provision of adequate nutritionally packed feeds for their cultured fish. Additives are also needed to boast the health and growth performance of the fish which are in an enclosed environment. A number of feed additives are available to improve the growth and productivity of these cultured fish but they are very expensive and also pose issues of leaving residues that may lead to public health risk and environmental contamination (Diyaware *et al.,* 2013).

In other to manage these challenges an alternative approach to fish feed is very necessary. The utilization of plant and fruit waste are of particular interest because this addresses the case of waste recycling, waste reduction as well as a competition for human food (Zenebe *et al.,* 2013). These waste materials are recycled by being utilized as raw materials for the production of feed additives as such are reintroduced into the food chain. Waste fruits and vegetables as well as their by-products have not been used much in compound feed in aquaculture (Zenebe *et al.,* 2013). However, they are sometimes used fresh, for feeding or as manure in the pond Fruits and vegetables are usually available in large quantities seasonally as a result the waste and by-products are also available intermittently in large volumes, but they are not normally or adequately preserved for other purposes or uses as the case maybe. The enormous waste of these fruits and vegetable in our immediate environment (shops, markets, malls, kiosk etc.) has emerged the concern of integrating these items to the aquaculture system to enhance and boost the nutritional need of the aquatic organisms (Zenebe *et al.,* 2013).

Examples of Fruits and vegetables includes; Grapes, tomatoes, bananas, plantains, mangoes, citrus fruits, pineapples, watermelons etc. root crops, such as yam and sweet potatoes are also an excellent source of energy for many livestock and it is rich in carbohydrate, their value as ingredients of aquaculture feeds are limited as a result of the high value for demand by humans (Suloma, & Ogata 2016). However, some aquatic species cannot digest carbohydrates readily. Some root crops have special value in aquaculture because of their ability to increase the water stability of diets. Examples include potatoes, cassava, carrots, yam (Suloma, & Ogata 2016). The waste from the processing of these fruits and vegetables, constitutes a large untapped source of energy and protein. Utilization of these resources, should be greatly encouraged by fish feed production companies as it will help boost fish health and production

Lack of proper utilization of these commodities poses hazardous trials to the environment as a result of improper disposal of the items which may also lead to pollution. Very little emphasis has been given to the use of fruits and vegetable in the production of fish feed. They are easily available and abundant in their various seasons and relatively cheap to afford. Fish production is increasing to meet the protein demands of growing human population, thus the quest to produce more protein has led the scientific community to attempt to improve the productivity of existing domestic species. For instance, through improved nutrition, genetic selection and better management procedures (Hoffman, 2008).

The use of plant-derived materials as fish feed ingredients is mostly limited by the presence of a wide range of anti-nutritional substances which includes protease inhibitors, phytates, glycosylates, saponins, tannins, lectins, oligosaccharides and non-starch polysaccharides, phytoestrogens, alkaloids, antigenic compounds, gossypols, antivitamins and phorbol esters (Omoregie *et al.,* 2009). Omoregie *et al,* (2009) also noted that protease inhibitors, phytates,

antigenic compounds and alkaloids, at levels usually present in fish diets containing commercially available plants-derived protein sources, are unlikely to affect fish growth performance. In contrast, glucosinolates, saponins, tannins, soluble non-starch polysaccharides, gossypol, and phorbol esters are more important from a practical point of view. However, as noted by Kays (2009), the sweet potato peel is devoid of most of these agents as the sweet potato plant usually stores these chemicals in its tubers.

Gabriel *et al,* (2007) reported that 50 to 60% of aquaculture production cost is used on fish feed which has made it necessary for research on cheaper, locally and readily available feed stuffs that can serve as alternative feed for fish. Watermelon contains vitamins, proteins, minerals, fat and carbohydrates (Hrubec *et al.,* 2010) while its peel, which is usually discarded as food waste, contains remarkable amount of most nutrients like phenolic antioxidants, flavonoids and lycopene (Collins *et al.,* 2007). Watermelon peel is also reported to contain appreciable amount of good dietary energy and is good for feeding Nile tilapia (Masudul *et al.,* 2015).

Tilapia is a popular fish for aquaculture as it is very versatile and is tolerant of a variety of aquaculture environment, it can be farmed in brackish or salt water and also in pond or cage system. Tilapia has become the third most important fish in aquaculture after carp and salmon; worldwide production exceeded 1.5 million metric tons ($1.5 \times 10^6$ tons) in 2002 (Feessehaye and Yona (2006) and increases annually. Due to their high protein content, rapid growth and palatability they are given major focus attentions. Tilapia fisheries originated in Africa and levant region in Asia. Tilapia are among the easiest and most profitable fish to farm due to their omnivorous diet, mode of reproduction (the fry does not pass through a planktonic phase), tolerance of high stocking density, and rapid growth.

Tilapia raised in inland tanks or channels are considered safe for the environment since their waste and disease is contained and not spread to the wild commercially grown tilapia are almost exclusively males. Being prolific breeders, female tilapia in the pond or tanks will result in large populations of small fish. Tilapia from aquaculture contains high ratios of omega-6 to omega-3 fatty acids Male tilapia fishes are preferred by fish farmers because they tend to grow faster than their female counterparts which spends more of their energy in the course of breeding. These activities the female tilapia get involved with is basically responsible for their stunted growth and to the advantage of the male tilapia which grows to a better table size than the females. Techniques are being researched by scientists to produce only male tilapia fish. Cultured tilapia fish can be really delicious in meals as well as a lucrative source of extra

According to Jauncey & Ross (2010) Fish feed has been confirmed as the most expensive input factor in development and operation of aquaculture system. This high cost of feed is due to massive reliance on the limited and costly protein sources for feed formulation like fishmeal and shrimp meal (Lim *et al.,* 2011). Omoregie (2001) reported that the shortage and high-cost of fish feed severely constrained the development and operation of low-cost aquaculture systems suitable for small-scale farmers in the developing countries like Nigeria. It would therefore, be more economical to utilize plant protein in fish feed formulation than high-cost animal protein materials.

According to Masudul *et* al., (2015) watermelon peel contain appreciable amount of dietary nutrition for fish feed, Watermelon contains vitamins, proteins, minerals, fat and carbohydrates (Hrubec *et al.,* 2010) while its peel, which is usually discarded as food waste, contains remarkable amount of most nutrients like phenolic antioxidants, flavonoids and lycopene

(Collins *et al.,* 2007). Kays (2009) reported that sweet potato peel is devoid of most of the anti-nutrition agents as the sweet potato plant usually stores these chemicals in its tubers. hence, there is need to examine the potential of these two non-conventional ingredients (watermelon and sweet potato peels).as inclusion in fish feed formulation for Tilapia fingerlings in order to maximize fish yield and also reduce the rate of wastage of these peels.

This study is aimed at maximizing the use of watermelon (*Citrullus lanatus*) peels and sweet potatoes (*Ipomoea batatas)* peels as fish feed inclusion to enhance fish yield of Tilapia (*Oreochromis mossambicus)* fingerlings and reduce wastage of these fruits and vegetable, the specific objective is to examine the nutritional utilization of Tilapia fish under dietary inclusion of sweet potatoes peels and watermelon peels. This study would be important to key players in the aquiculture sector which includes commercial fish feed producing firms, small, medium and large-scale fish farmers as well as intending and potential fish farmers. The finding of this study will help them to understand the possibilities of using watermelon and sweet potatoes peel as part of the material for formulation of fish feed. The finding of this study will also be useful to scholars and researchers in plant science and animal science, especially those in aquaculture related field because it will serve as reference material which will guide them in studies that are related to this current study.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

This study was carried out at the African Regional Aquaculture Center (ARAC) Aluu, Ikwerre Local government area, Port Harcourt Rivers State Nigeria.

### 2.2 Experimental Design

Seventy-two (72) mixed sexed fingerling tilapia fishes of initial weight of $10.72 \pm 0.43g$ were used. The fingerlings were acclimatized in a wide small concrete pond for three days before being transferred to their respective experimental ponds. The fish samples were distributed into four different treatment groups in three replicas and each replica contained 6 fingerlings placed in a woven net arrangement and placed in a large (10m by 15m by 7m) concrete pond capable of holding $1000m^3$volme of water. Thus, there were three fish ponds used in this experiment each fish pond contained four (4) woven net arrangement with six fishes in each woven net arrangement for each treatment group. Each fish pond was used for separate feed treatment group designated as C, T1, T2 and T3. C was the control experiment treatment group in which the fishes in woven net were fed with the normal fish feed. T1 was the experiment set up for treatment group in which the fishes in the woven net are fed with normal feed mixed with dried sweet potatoes peel, T2 was the treatment group in which the fishes in the woven net are fed with normal fish feed mixed with dried watermelon peel and T3 was treatment group in which the fishes were fed with normal fish feed mixed with both dried watermelon and sweet potatoes peels. In total there are twelve (12) woven nets arrangement distributed evenly in three (3) large concrete ponds such that each pond is responsible each replica of the four (4) treatment group as explained thus. see Plate 1




**Plate 1: The woven net arrangement in the Fish Pond.**

**2.2.1 Duration**:

The experiment started on the 3rd day of March and ended 26th May 2022 making it a total of 14 weeks, however, the data which includes the weight, standard length and total length of the fishes were taken before stocking them in the ponds and after which they were measured biweekly alongside the water parameters

**2.2.2 Feed formulation and Feeding:**

35% crude protein diet was formulated using the person square method which allowed the inclusion of other materials (watermelon peels and sweet potato peels) see Table 3.1. The experimental fishes were feed at 5% of their body weight daily morning and evening between the hours of 9am- 5pm during the course of this study respectively.35% crude protein diet was formulated using the Pearson square method which allowed the inclusion of other materials (watermelon peels and sweet potato peels) See Table 1. NOTE: The control diets were produced using only the regular fish feed materials. Four different feeds were formulated and were labeled

Feed 1: C (normal feed without inclusion)
Feed 2: T1 (Sweet potato peels inclusion)
Feed 3: T2 (Water melon peel inclusion)
Feed 4: T3 (Both inclusion)

**Table 1 The Feed Content of the Four feed samples used in the Experiment**

| | 10 KG fish feed diet, 35%CP | | | | |
|---|---|---|---|---|---|
| | **CONTROL** | **T1** | **T2** | **T3** | |
| | | WMP | SPP | BOTH | TOTAL KG |
| **WATERMELON PEEL** | 0.00000 | 1.609385 | 0.00000 | 1.122813 | 2.732197 |
| **SWEET POTATO PEEL** | 0.00000 | 0.00000 | 1.667077 | 1.122813 | 2.789889 |
| **WHEATBRAN** | 2.803333 | 1.609385 | 1.667077 | 1.122813 | 7.202607 |
| **GARRI** | 0.560667 | 0.268231 | 0.277846 | 0.224563 | 1.331306 |
| **SOYABEAN** | 3.068 | 3.0065 | 2.944 | 2.9535 | 11.972 |
| **FISHMEAL** | 3.068 | 3.0065 | 2.944 | 2.9535 | 11.972 |
| **PALM OIL** | 0.3 | 0.3 | 0.3 | 0.3 | 1.2 |
| **BONEMEAL** | 0.04 | 0.04 | 0.04 | 0.04 | 0.16 |
| **SALT** | 0.04 | 0.04 | 0.04 | 0.04 | 0.16 |
| **PREMIX** | 0.04 | 0.04 | 0.04 | 0.04 | 0.16 |
| **METHIONINE** | 0.04 | 0.04 | 0.04 | 0.04 | 0.16 |
| **VIT.C** | 0.04 | 0.04 | 0.04 | 0.04 | 0.16 |
| **Total** | 10 | 10 | 10 | 10 | 40 |

Where T1 = feed with Watermelon peel inclusion, T2 = feed with sweet potato peel inclusion, T3 = feed with both watermelon and sweet potatoes peel inclusion and C = feed without the peel.

### 2.3 Data collection

The first data collection was on the water quality of the pond. Five major parameters were considered on water quality and they include, Dissolved oxygen Content, Temperature, pH, Ammonia content and Nitrate content. The main data collection was focused on parameters that are required to nutrient Utilization of the fishes in the experiment which is basically the initial and Final weight after each period, ($W_1$ and $W_2$) and the total feed intake.

#### 2.3.1 Procedure used to measure the weight of the fishes;

The fishes were carefully harvested from each pond into a bucket and moved to measurement Table. Weighing balance were used to measure the weight of the fishes. After the measurement, they were returned to the ponds see plate 1




**Plate 1 Procedure for measurement of Initial and final weight**

### 2.4 Feed utilization Parameters

1. **Feed Conversion Efficiency.** This is evaluated according to formula used by Solomon et al (2015) as
   $$\mathbf{FCE} = \frac{\boldsymbol{change\ in\ wight}}{\boldsymbol{feed\ intake}} \times \mathbf{100} = \frac{\mathrm{W2} - \mathrm{W1}}{\boldsymbol{feed\ intake}} \times \mathbf{100}\ \mathbf{(\%)}$$
2. **Feed Conversion Ratio:** This is evaluated according to formula used by Solomon et al (2015) as
   $$\mathrm{FCR} = \frac{\boldsymbol{Feed\ Intake}}{\boldsymbol{Change\ in\ weight}} = \frac{\boldsymbol{feed\ Intake}}{\mathrm{W2} - \mathrm{W1}}$$ (no unit)

### 2.5 Data analysis and Presented

All data used in this study were presented in form of mean±standared error. The effects of feeding treatment on different treatment group were analyzed using one-way ANOVA as was used in Marconato et al (2020). Duncan's New Multiple Range Test was used to separate differences among the various means using the SPSS software Version 20 and Microsoft office Excel program 2010 is also used in developing graphs and other relevant charts.

## 3. RESULTS AND DISCUSSIONS

### 3.1 Feed Utilization Indictors

In this study, two major feed utilization indicators were considered and they include; feed conversion ratio (FCR) and feed conversion efficiency (FCE)

#### 3.1.1 Feed conversion ration

Feed Conversion Ratio is a feed utilization indicator that measures the amount of feed required to achieve a unit gain in weight of the fish. The lower the feed conversion ratio the better the performance of the fish sample: thus, the feed sample with low FCR is considered a better feed because it takes only small portion of the feed to achieve a unit gain in weight**.**

Table 2 and Figure 1 show the results of feed conversion ratio of the fish samples feed with the four different feed samples., The results revealed that fish samples fed with the control feed sample had the best and significant feed conversion ratio ($0.87^{a}$) followed by fish samples fed with T3 feed sample ($1.18^{c}$) while those fed with T1 feed sample showed the lowest and significant feed conversion ratio ($1.43^{b}$). These results mean that fish sample feed with the control feed sample showed the best feed utilization based on feed conversion ratio within the 14 weeks of feeding trial followed by those fed with feed sample with combined sweet potatoes peel and watermelon while those fed with feed that contain only sweet potatoes showed the lowest feed utilization based on feed conversion ratio. This best performance shown by control feed sample could be attributed to the facts that the control feed has all the necessary nutrient with little or no anti-nutrition therefore a small amount of the feed contain enough nutrient that would produce a unit increase in the weight of the fish samples fed with feed while the lowest growth performance observed in feed with only sweet potatoes peel could be attributed to presence of anti-nutrition agent and limited minerals and vitamins in the feed which tend to hinder the feed absorption thus, more of the feed is required to generate a unit increase in the body weight of the feed samples fed with the feed. However, the combination of sweet potatoes peel to water melon made a better compensation for by introducing the mineral and vitamins

that counters the activities of the anti-nutrient thereby improving the feed utilization of the fish sample as compare to feed with only sweet potatoes peels.

**Table 2 Results of Feed Conversion Ratio of the Fish Samples**

| Variables (g) | Control | T1 | T2 | T3 |
|---|---|---|---|---|
| Initial weight | 10.43± 0.14[a] | 11.05± 0.34[a] | 10.32± 0.35[a] | 11.08± 0.54[a] |
| Final weight | 91.00± 0.11[a] | 62,50± 0.76[b] | 55.67± 0.72[c] | 74.67± 0.43[d] |
| Change in weight | 80.57± 0.13[a] | 51.45± 0.55[b] | 45.15± 0.54[c] | 63.59± 0.49[d] |
| Total feed consumed | 69.72± 0.03 | 73.46± 0.07 | 63.63± 0.06 | 74.98± 0.07 |
| FCR | 0.87[a] | 1.43[b] | 1.41[b] | 1.18[c] |

Note; Values in the same row with same superscripts are not significantly different at 0.05 probability level and values in parentheses are standard errors of mean values.

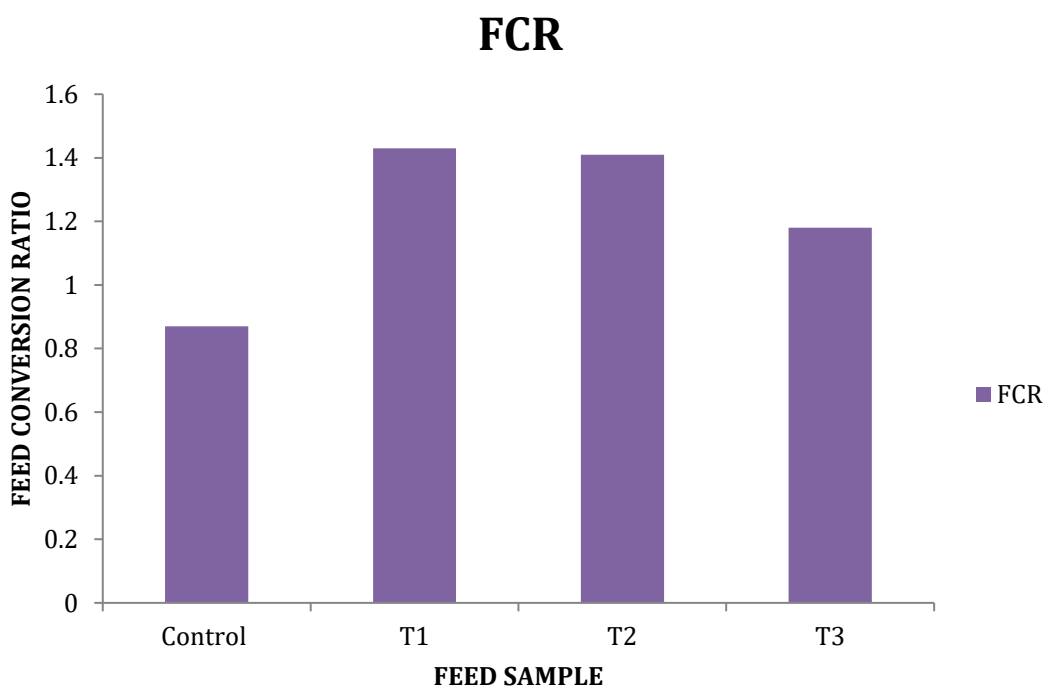


**Figure 1 Bar chart of the Feed Conversion Ratio of the Fish sample Fed with the four Feed samples**

### 3.1.2 Feed conversion efficiency (FCE)

Feed Conversion Efficiency is the feed utilization indicator that expresses the ability of the feed to trigger increase in weight of the fish sample. Thus, feed with higher feed conversion efficiency possess the necessary nutrient to cause a higher increase in weight of the feed after consumption. Table 3 and Figure 2 show the results of feed conversion efficiency of the fish samples feed with the four different feed samples. The results revealed that fish samples fed with the control feed sample had the best and significant feed conversion efficiency (116[a]) followed by fish samples fed with T3 feed sample (85[c]) while those fed with T1 feed sample showed the lowest and significant feed conversion efficiency (70[b]).

These results mean that fish sample feed with the control feed sample showed the best feed utilization based on feed conversion efficiency within the 14 weeks of feeding trial followed

by those fed with feed sample with combined sweet potatoes peel and watermelon while those fed with feed that contain only sweet potatoes showed the lowest feed utilization based on feed conversion efficiency. This best performance shown by control feed sample could be attributed to the facts that the control feed has all the necessary nutrient with little or no anti-nutrition therefore a small amount of the feed contain enough nutrient that would produce a unit increase in the weight of the fish samples fed with feed while the lowest growth performance observed in feed with only sweet potatoes peel could be attributed to presence of anti-nutrition agent and limited minerals and vitamins in the feed which tend to hinder the feed absorption thus, more of the feed is required to generate a unit increase in the body weight of the feed samples fed with the feed. However, the combination of sweet potatoes peel to water melon made a better compensation for the anti-nutrient by introducing the mineral and vitamins that counters the activities of the anti-nutrient thereby improving the feed utilization of the fish sample as compare to feed with only sweet potatoes peels.

**Table 3 Results of Feed Conversion Efficiency of the Fish Samples**

| Variables (g) | Control | T1 | T2 | T3 |
|---|---|---|---|---|
| Initial weight | $10.43\pm 0.14^{a}$ | $11.05\pm 0.34^{a}$ | $10.32\pm 0.35^{a}$ | $11.08\pm 0.54^{a}$ |
| Final weight | $91.00\pm 0.11^{a}$ | $62,50\pm 0.76^{b}$ | $55.67\pm 0.72^{c}$ | $74.67\pm 0.43^{d}$ |
| Change in weight | $80.57\pm 0.13^{a}$ | $51.45\pm 0.55^{b}$ | $45.15\pm 0.54^{c}$ | $63.59\pm 0.49^{d}$ |
| Total feed consumed | $69.72\pm 0.03$ | $73.46\pm 0.07$ | $63.63\pm 0.06$ | $74.98\pm 0.07$ |
| FCE (%) | $116^{a}$ | $70^{b}$ | $71^{b}$ | $85^{c}$ |

Note; Values in the same row with same superscripts are not significantly different at 0.05 probability level and values in parentheses are standard errors of mean values.

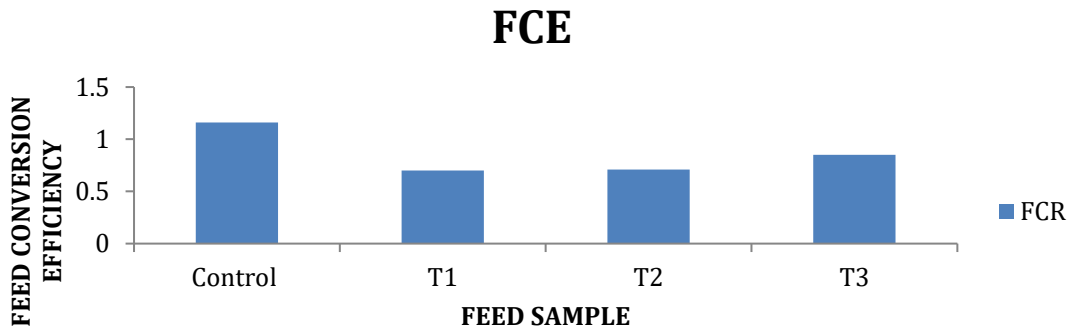


**Figure 4.14 Bar chart of the Feed Conversion Efficiency of the Fish sample Fed with the four Feed samples**

## 4. CONCLUSION

The study was carried out to investigate feed utilization of Tilapia under dietary inclusion of sweet potatoes peels and watermelon peels. Based on the finding of the study it was concluded that using both dried water-melon peel and dried sweet potatoes peel as inclusion in formulation of fish feed for tilapia will provide significantly improve on their feed utilization compare to using only dried water-melon peel and dried sweet potatoes. However, the feed sample without inclusion of both dried water-melon peel and dried sweet potatoes peel is still be best in improving the nutrient and feed utilization of the fish samples based on both feed conversion ratio and feed conversion efficiency

## REFERENCE

Gabriel U.U., Akinrotimi O.A., Bekibele D.O, Onunkwo D.N & Anyanwu PE (2007). Locally produced fish feed, potentials for aquaculture development in sub-Saharan. *African Journal of Agricultural Research* 297:287-295.

Hrubec T.C., Cardinale J. & Smith S.A (2010). Haematology and plasma chemistry reference intervals for cultured tilapia (Oreochromis hybrid), *Veterinary Clinical Pathology*, 29:7-12

Jimoh, W. A., Shittu, M. O., Abdulsalami, S. A., Okemakin, F. Y. and Ayeloja, A. A (2018) Effect of replacing soybean meal with water melon seed meal on the growth, feed utilization and body composition of Nile tilapia (Citrullus lanatus Oreochromis niloticus, Nigerian Journal of Animal Production, 45(2) 59-66

Kays S.J (2009) The physiology of yield in the sweet potato. In: JC Bouwkamp (Ed.) Sweet Potato Products - *A Natural Resource for the Tropics, CRC Press, Florida, USA*. 2009.

Lim C., Beames, Eales R.M., Prendergast J.G., Mcleese A.F., Shearer J.M & Higgs. DG (2011) Nutritive values of low and high fibre canola meals for shrimps (Ipenaeus vannamei). *Aqua-culture. Nutrition* 3: 269 – 279.

Marconato, A. M., Hartmann, G. L., Santos, M. M. R., Amaral, L. A., Souza, G. H. O., Santos, E. F., & Novello, D. (2020). Sweet potato peel flour in hamburger: effect on physicochemical, technological and sensorial characteristics. *Brazilian Journal of Food Technology, 23*, e2019115. https://doi.org/10.1590/1981-6723.11519

Masudul M. Hoque, & Abdullah I (2015) Drying of Watermelon Rind and Development of Cakes from Rind Powder. *International Journal of Novel Research in Life Sciences*, 2(1):14-21.

Omoregie E., Igoche L., Ojobe T.O., Absalom K.V & Onusiriuka B.C (2009) Effect of Varying Levels of Sweet Potato (Ipomea Batataspeels on Growth, Feed Utilization and Some Biochemical Responses of the Cichlid (Oreochromis Niloticus), African Journal of Food, Agriculture, Nutrition and development, 9(2) ISSN 1684-5376

Omoregie E & Ogbemudia F.I (1999) Effect of substituting fishmeal with palm kernel on growth and food utilization of the Nile Tilapia, (Oreochromis niloticus) *Israeli Journal of Aqua-culture*. 43: 113 – 119.

Omoregie E (2001) Utilization and nutrient digestibility of mango seeds and palm kernel meal by juvenile Labeo senegalensis (Antheriniformes: Cyprinidae) *Aqua cultural. Reserve*; 32: 681 – 687.

Solomon, S.G., Okomoda, V.T & Oloche, J. A. (2015) Evaluation of Sweet Potato (Ipomea batatas) Peel as a Replacement for Maize Meal in the Diet of Clarias gariepinus Fingerling. *Fisheries Science 9*(4): 063-068

Zenebe T, Abeba W.G., Mulugeta J., Fekadu T & Fasil D (2012). Effect of supplementary feeding of agro-industrial byproducts on the growth performance of Nile tilapia

[Oreochromis niloticus) in concrete ponds, *Ethiopian Journal of Biological Science* 11(1): 29-41.

Collins J.K, Wu G., Perkins-Veazie P., Spears K., Claypool P.L & Baker RA (2007). Watermelon consumption increases plasma arginine concentrations in adults. *Nutrition* 23(3):261-266Diyaware *et al.,* 2013).

Highlights: Exact solutions for three dynamical regimes; mechanical energy balance; numerical cross-check; reproducible synthetic data estimation; limitations and laboratory validation proposed.