GROWTH PERFORMANCE AND FEEDING EFFICIENCY OF GOLDFISH (*Carassius auratus*) AND RED CAP ORANDA FISH (*Carassius auratus auratus)* BY USING DIFFERENT LOCALLY PREPARED FEED MIXED WITH DIFFERENT PLANT EXTRACTS AT PAKLIHAWA, NEPAL.

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ABSTRACT

A research was done at Aquaculture department laboratory of Institute of Agriculture and Animal Science Paklihawa Campus, Rupandehi from 28 February 2017 to 28 April 2017 using two ornamental fishes ; Goldfish (*Carassius auratus*) and Red cap oranda (*Carassius auratus auratus*) . Twelve rectangular glass aquarium of size of 12" × 24" × 12" were used for the purpose to assess the growth performance and feeding efficiency. Four treatments selected for this purpose were local feed containing rice bran and mustard oil cake (MOC) in T1 (Control), Local Feed with 5% Cassava leaves powder in T2, Local Feed with 5% Sweet Potato leaves powder in T3 and Local Feed with 5% *Colocasia* leaves powder 5% T4 during the experimental period. The initial weight of red cap was significantly lower in T3 as compared to T1 but was at par with T2 and T4. Furthermore, the final weight was not significantly different among the treatments. In case of goldfish, the initial weight at T4 was significantly lower than T2 but was at par among other treatments. The final weight was significantly higher in T2 as compared to T4 and T3 was at par with T1. Feed conversion ratio (FCR) was observed higher in case of T2 (6.981±3.14) and lower in case of T3 (3.325±0.48). However, no significant difference was noticed among the treatments. Specific growth rate (SGR) was observed higher in T3 (0.0370±0.088) as compared to other treatments. However, in this case also, no significant difference was observed. Survivability percentage for red cap fish was observed higher in T3 (100±0.00) and least inT2 (50.000±40.82), whereas, survivability was 100% for goldfish in all the treatments. The average survivability was highest (100%) in T3 for both kinds of fishes and minimum in T2 (75±20.41). Also, the mean pH observed at T1, T2, T3 and T4 was 9.165, 9.222, 9.196 and 9.172 respectively. Similarly, daily mean dissolved oxygen recorded at T1, T2, T3 and T4 was 6.23 mg/l, 6.16 mg/l, 6.267mg/l and 6.147 mg/l respectively. Moreover, the mean average temperature recorded in these four treatments; T1, T2, T3 and T4 were 23.342 ^{O}C, 23.272 ^{O}C, 23.342 ^{O}C and 23.339 ^{O}C respectively.

Keywords: Plant extracts, Goldfish, Red cap oranda fish, Cassava leaves, Sweet Potato leaves, Colocassia leaves and Feed Nutrition

INTRODUCTION

Nutrition is one of the key factors in improving production efficiency of ornamental fish. The other factors include growth, health, body color and breeding of these fishes. Nutritional requirements and feed management needs in ornamental fish are determined mainly based on the information of these and the experiences of successful aquarist in the line. Fish feed is the most expensive input during aquaculture operations. The high cost of feed arises from extensive reliance on animal protein sources, such as fishmeal and shrimp meal (Omoregie, 2001). Shortage and high cost of pelleted feed severely constrains the development of low cost aquaculture systems suitable especially for small-scale farmers. Therefore, there is a need to assess the potential of non-conventional raw ingredients

before use in fish diets. Good nutrition in animal production systems is essential to economically produce a healthy and high quality product. According to Omoregie and Ogbemudia (1993), fish nutrition has advanced dramatically in recent years with the development of balanced commercial diets for promoting optimal fish growth and health. However, as the cost of fish production continue to escalate due to soaring feed prices owing to extensive use of expensive animal protein like fish meal, aquaculture production becomes a less or non-profitable enterprise (El-Sayed, 2006). . Therefore, it is necessary to explore utilization of plant proteins in fish feeds as substitutes for expensive animal protein materials (Omoregie and Ogbemudia, 1993). Fish meal has become the most essential protein for commercial aquaculture feeds. It provides the fish with high quality protein, an essential amino acid profile and has high palatability (Li *et al.*, 2006). As fish meal is expensive and inaccessible to small scale fish farmers, there is a need of replacing fish meal with cheaper ingredients (Higgs *et al*., 1995). Plant proteins are likely candidates because of local availability and low cost (Lim and Webster, 2006). Substituting fishmeal with plant protein ingredients can reduce the fish growth (Francis *et al*., 2001). Despite its associated challenge, the current study, aims at evaluating the nutritional potential of plant ingredients.

Cassava (*Manihot esculenta*, Crantz) contains 27.39-30.8% protein content. As an all – season crop as food in several parts of Africa (Nigeria inclusive), Asia and Latin America is well documented (Longe, 1980; Rosling, 1987; Bradbury *et al.*, 1991). Besides protein, it contains minerals, Vitamin B1, B2, C and carotenes (Eggum, 1970; Adewusi and Bradbury, 1993).

Colocasia contains 30.0-33.5% protein content. It is widely produced throughout the world for its underground corms (Njintang *et al.,* 2007). The nutritional value is the main concern when a crop is being considered as a food source. Due to the emphasis placed on the nutritional value of food by consumers, a great need exists for information on the nutritional contents of root crops (Huang, *et al.,* 2007). Starch is the most important component (73-80%) of taro (Njintang *et al.,* 2007). It contains about 11% protein on a dry weight basis. This is more than yam, cassava or sweet potato. The protein fraction is rich in essential amino acids of trionine, leucine, arganine, valine and phnylalanine. Among the essential amino acids methionine, lycine, cystine, phnylalanine and leucine are relatively abundant in the leaf than the corm (FAO, 1999).

Sweet potato contains 29.18-35.3% protein content. Among other root and tuber crops, contains higher contents of carbohydrates, various vitamins, minerals, and protein than other vegetables (Shih *et al.,* 2007).

Goldfish (*Carassius auratus)* belongs to the family Cyprinidae of order Cypriniformes. Goldfish is primarily a freshwater fish regarded to be one of the most popular pet fishes of the world. Goldfish tends to measure average 12" inches in length. Body colour of goldfish is combinations of white, yellow, orange, red, brown, and black are known. Different sources claim maximum recorded sizes anywhere from 19 inches to 23 inches with a maximum weight of 4.5 kg. Goldfish are long lived fish with a reported expectancy of 5-10 years in captivity. Goldfish can vary greatly in size, body shape, fin configuration and coloration due to intensive selective breeding.

Red Cap Oranda Fish (*Carassius auratus auratus)* also belongs to family Cyprinidae of order Cypriniformes. The beautiful Red Oranda Goldfish usually reaches about five inches in length. This goldfish has a large growth over its head known as a wen. Red Oranda Goldfish has long fins, including a dorsal fin. They have veil tail type tails and double caudal fins. Red Oranda Goldfish requires warmer temperatures, usually around 70 to 80 degrees Fahrenheit. However, they are quite hardy and will tolerate a variety of temperatures in this immediate range. The pH level for Red Oranda Goldfish should remain between 7.0 and 8.0.

The general objective of this study was to assess the growth performance and feeding efficiency of Goldfish and Red Cap Oranda fish in different treatments. Whereas, the study specifically aimed to:

- Assess the growth performance of both fishes fed with different types of plant extracts mixed feeds in different treatments.
- Assess the overall water quality parameters during the study period.

MATERIALS AND METHODS

Experimental setup

The study was done at Aquaculture lab of IAAS Paklihawa, Rupendehi from 28 February 2017 to 28 April 2017. Twelve glass aquarium tanks (12" × 24" × 12"), each ¾ filled with water were aerated continuously using an air compressor.

The aquarium, aerator as well as fingerlings of Goldfish and Red cap oranda were brought from Prashan Aquarium and Plantation, Bhairahawa. The experiment was setup in a Completely Randomized Design (CRD) with 4 treatments and 3 replications. Four types of feed were provided to test the growth rate of the carp fish. The local feed was prepared by mixing mustard oil cake (MOC) and Rice Bran in 1:1 ratio and then it was grinded manually and then the feed was kept for sun drying over one week. Cassava leaves extract (5%) was mixed with local feed thoroughly in the tray. The thoroughly mixed feed was grinded manually to appropriate size for fingerling feeding and then the feed was kept for sun drying over one week.Sweet Potato leaves extract (5%) was mixed with local feed thoroughly in the tray. The thoroughly mixed feed was grinded manually to appropriate size for fingerling feeding and then the feed was kept for sun drying over one week. Colocasia leaves (5%) were mixed with local feed thoroughly in the tray. The thoroughly mixed feed was grinded manually to appropriate size for fingerling feeding and then the feed was kept for sun drying over one week.

The number of stocking density of fishes in each aquarium consists of 2 Goldfish and 4 Red Cap Oranda fish in each aquarium. 4 treatments along with 3 replications were made as follows:

T1 - Fish fed with local feed (Control)
T2 - Fish fed with local feed (Cassava leaves 5 %)
T3 - Fish fed with local feed (Sweet potato leaves 5%)
T4 - Fish fed with local feed (Colocasia leaves 5%)

Table 1: Treatment and Replications in each Aquarium

Treatment	T1	T2	T3	T4
R1	T1R1 (1)	T2R1(2)	T3R1 (3)	T4R1 (4)
R2	T1R2 (5)	T2R2 (6)	T3R2 (7)	T4R2 (8)
R3	T1R3 (9)	T2R3 (10)	T3R3 (11)	T4R3 (12)

(Note: The numerical inside the brackets represent the number of aquariums)

The fingerlings were fed on the basis of average body weight in different aquariums. The formula used for different calculations is given below:

Average weight of the individual fish species = Total weight of the individual fish species (Kg)/Total no.of individual fish

Weight Gain (WG) = Final average weight (g) − initial average weight (g)

Specific Growth Rate (SGR) (% / day) = {(Ln. Final body weight – Ln. Initial body weight) / days} X 100

% Weight gain = (Final body weight – Initial body weight / Initial body weight) X 100
FCR = Food fed (g dry weight) / Live weight gained (g)

Water quality analysis

pH: The pH of the water was measured daily at 8:00-9:00am with the help of digital lutron pocket type model 201 pH meter.

Dissolved Oxygen (DO): Dissolved oxygen was recorded daily at 8:00-9:00 am by using Lutron model 5510 dissolved oxygen meter.

Temperature: The temperature was measured with the dual purposed calibrated DO meter at the same time of measuring of DO.

Fish sampling and growth measurement:

The fish sampling was done fortnightly by using electronic balance, scoop net and plastic bucket and other equipment.

Statistical analysis:

The statistical analysis of data was performed by using SPSS (version 16.0). Microsoft excel computer program was used for data tabulation and figure preparation.

RESULTS AND DISCUSSION

Fish yield

The initial weight of red cap was significantly lower in T3 as compared to T1 but was at par with T2 and T4 (Table 2). Furthermore, the final weight was not significantly different among the treatments. In case of goldfish, the initial weight at T4 was significantly lower than T2 but was at par among other treatments. The final weight was significantly higher in T2 as compared to T4 and T3 was at par with T1.

Table 2: Stocking and harvest weight of Redcap and Goldfish (Mean± SE)

Parameters	T1	T2	T3	T4
Total No. of Redcap	12	12	12	12
Initial weight (kg)	0.013±0.0009^{a}	0.013±0.0005^{ab}	0.0125±0.0005^{b}	0.0132±0.0008^{ab}
Final weight (kg)	0.023±0.0049^{a}	0.017±0.0079^{a}	0.0233±0.0032^{a}	0.0214±0.0059^{a}
Total No. of Goldfish	6	6	6	6
Initial weight (kg)	0.018±0.0015^{ab}	0.021±0.0005^{b}	0.018±0.0010^{ab}	0.016 ±0.0045^{a}
Final weight(kg)	0.034±0.0568^{abc}	0.037±0.0043^{a}	0.0298±0.004 ^{a}	0.027±0.0062^{c}
Initial wt. of both fish (kg)	0.032±0.0034 ^{a}	0.033±0.0009 ^{a}	0.0298±0.004 ^{a}	0.0318±0.003 ^{a}
Initial wt. of both fish (kg)	0.055±0.0093 ^{a}	0.045±0.0066 ^{a}	0.0520±0.008 ^{a}	0.0510±0.008 ^{a}

In case of goldfish, the performance of feed mixed with Sweet potato leaves powder has remarkable outcome than the feed mixed with cassava and colocasia. However, in case of red cap fish, no significant difference was noted in the final weight. It is due to the average size of individual Red cap fish is comparatively smaller with 0.003 kg than Goldfish having 0.009 kg in stocking time period. Similarly it is also addressed with the justification that the handling stress during the time of changing water through the direct deep bored artisanal water system might have affected the accidental fluctuation in water quality parameters. As the fish size is estimated directly influence

by sudden changes in water quality deterioration. Furthermore, it is justified with the result that In case of initial wt. of redcap fish, there was significantly different in T1 than T3 and T3 than T1 respectively. There is no substantial increment in final average weight of both fishes with the same feedstuffs. The stocking average weight of single goldfish was found to be 0.009 kg and that of red cap was found to be 0.003 kg. The average harvest weight of single goldfish was found to be 0.015 kg and that of red cap was found to be 0.006 kg.

Feed conversion ratio (FCR) was observed higher in case of T2 (6.981±3.14) and lower in case of T3 (3.325±0.48). However, no significant difference was noticed among the treatments. Specific growth rate (SGR) was observed higher in T3 (0.0370±0.088) as compared to other treatments. However, in this case also, no significant difference was observed. Survivability percentage for red cap fish was observed higher in T3 (100±0.00) and least inT2 (50.000±40.82), whereas, survivability was 100% for goldfish in all the treatments. The average survivability was highest (100%) in T3 for both kinds of fishes and minimum in T2 (75±20.41). Though there is increment in case of particular weight gain in different treatments, but significance is least observed. But it might be due to the short time period of two months. Furthermore, seasonal stagnant in water quality parameters might influence the result.

Table 3: Feed Conversion Ratio, Specific Growth Rate% and Survival percentage of Red Cap and Gold Fish among different treatments (Mean± SE)

Parameters	T1	T2	T3	T4
FCR	3.474±0.96	6.981±3.14	3.325±0.48	4.593±2.47
SGR	0.037±0.011	0.019±0.011	0.0370±0.088	0.031±0.013
Survivability% Redcap	87.50±4.43	50.000±40.82	100.000±0.00	79.16±31.68
Survivability% Goldfish	100.00±0.00	100.00±0.00	100.00±0.00	100.00±0.00
Avg.Survivability% (both)	93.75± 7.217	75±20.41	100±0.00	89.58±15.84

Water Quality Analysis

Daily mean pH was recorded from 28th Feb. 2017 to 15th Mar. 2017. The mean pH was highest at T2 (9.222) and lowest at T1 (9.165). The mean pH of T3 and T4 was 9.196 and 9.172 respectively (Figure 1).

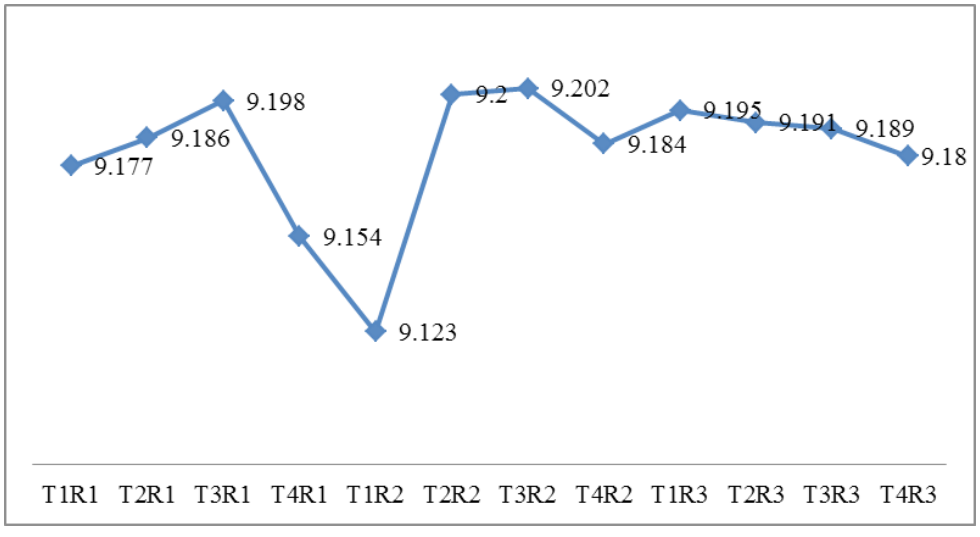

Figure 1: Daily mean pH of aquarium water in each treatment during the experimental period

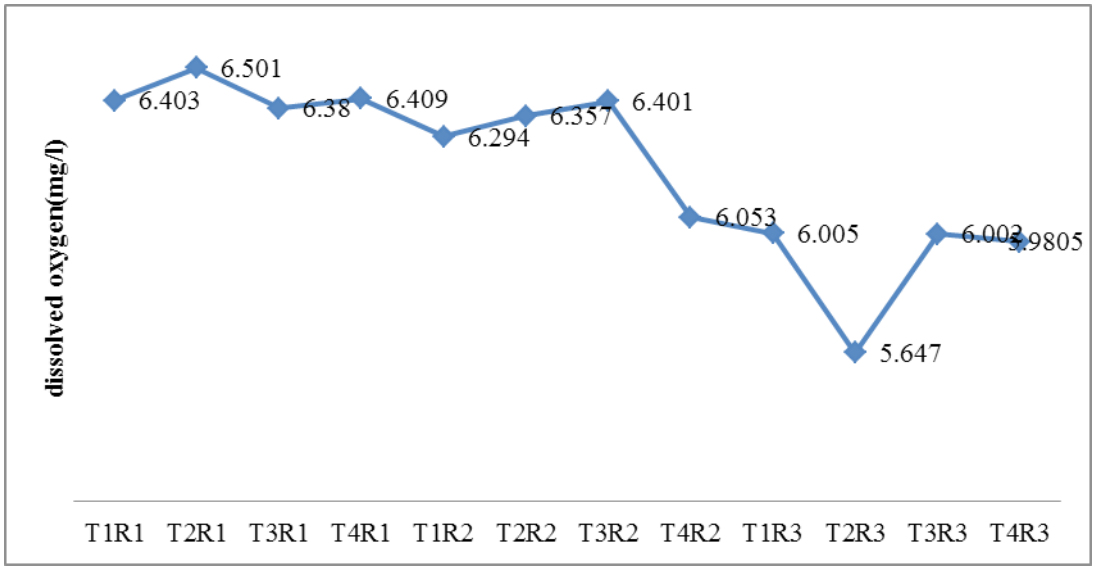

Figure 2: Daily mean dissolved oxygen of aquarium water in each treatment during the experimental period

Similarly, daily mean dissolved oxygen was found to be maximum at T3 (6.267mg/l) and minimum at T4 (6.147). The mean dissolved oxygen at T1 and T2 was 6.23 mg/l and 6.16 mg/l respectively (figure 2).

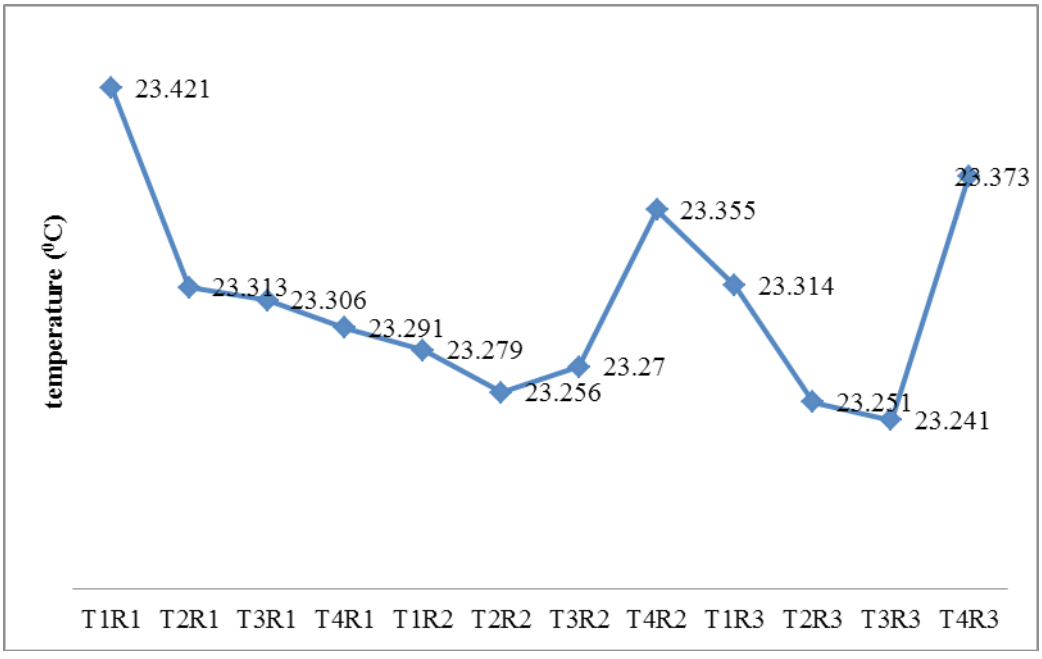

Figure 3: Daily mean temperature (^{O}C) of aquarium water in each treatment during the experimental period

The mean average temperature was recorded in T1 (23.342 ^{O}C) and minimum in T3 (23.342 ^{O}C). The mean average temperature recorded in T2 and T4 was 23.272 ^{O}C and 23.339 ^{O}C respectively.

There were no significantly different in water quality parameters in terms of pH, DO and Temperature in different four treatments in the period of two months of experimental period. Additionally, we had seen the effect of low DO on the red cap oranda fish which were more prone to low DO than the big sized goldfish resulting the mortality of red cap oranda fish. When the DO was lower than 4 mg/L, the small red cap started moving irregularly due to suffocation and started to float on the surface of the aquarium water. The DO of water was seen decreasing with increase in temperature due to seasonal variation of temperature. The pH was found comparatively normal ranging from 8-9 during the experimental period and was generally accepted by the fishes. The average pH varied in each aquarium from 9.12-9.20 in two months while the DO varied from 5.64-6.50 mg/l and the temperature varied from 23.241-23.421 ºC.

SUMMARY AND CONCLUSION

The application of different economically viable plant extracts in fish feed was found to be an innovative and low cost feeding technology for proper growth and development of goldfish and red cap Oranda fish. By the above result, we can conclude that if we can stock standard average size of Goldfish then it can directly influenced by the feed additives added with sweet potato leaves than other plant based extracts. We can also conclude that in the same way, the stocking density of Redcap oranda fish needs to be maintained with standard average size for proper growth and development with these sorts of feed additives.

ACKNOWLEDGEMENT

Last but not the least, the authors wish to acknowledge the support from Tribhuvan University/ IAAS for providing essential equipment, feed stuffs and laboratory facilities. The very genuine thanks are extended to our lab staff Mr. Dhan Bahadur Rana for his dedication and untiring continuous support and for those students who actively participated during the study time to make it happen productive in different phases of this work. Thanks also go to Dr. Shambhu Shah for his constructive outputs. At last, we would like to extend our sincere thanks to Prof. Dr. Kanhaiya Prasad Singh for his support and effort to make this research successful.

REFERENCES CITED

Adewusi, S.R.A., & Bradbur, J.H. (1993). Carotenoid in cassava; comparison of open column and HPLC methods of analysis. J. Sci. Food. Agri., 62: 375-383.

Bradbury, J.H., Egan, S.M., & Lynch, M.J. (1991). Analysis of cyanide in cassava using acid hydrolysis of cyanogenic glucosides. J. Sci. Food Agri., 55: 277- 290.

Edwards, P. & Allan, G.L. (2004). Feed and Feeding for inland aquaculture in Mekong region countries. ICIAR Technical Report. 56, 1-37.

Eggum, R.O. (1970). The protein quality of cassava leaves. Br. J. Nutr. 24: 761-768.

El-Sayed, A.F.M. (2006). Tilapia Culture. CABI Publishers, Oxfordshire, UK, 277 pp.reared in cold water. Aquaculture, 269, 414-426

FAO. (1999). Taro Cultivation in Asia and the Pacific, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

Francis, G., Makkah, H.P.S., & Becker, K. (2001). Anti-nutritional factors present in plant-derived alternate fish feed ingredients and their effects in fish. Aquaculture, 199: 197-227.

Higgs, D.A., Dosanji, B.S., Prendergast, A.F., Beams, A.F., Hardy, R.W., Riley, W., & Deacon, G. (1995.) Nutrition and Utilization Technology in Aquaculture. Chapman and Hall Company. New York. USA, 130-156

Huang, A.S. & Tanudjaja, L.S. (1992). Application of anion exchange high-performance liquid chromatography in determining oxalates in taro (*Colocasia esculenta* (L.) Schott) corms. Journal of Agriculture and Food Chemistry, 40: 2123–2126.

Li, M.H., Peterson, B.C., Jones, C.L., & Robinson, E.H. (2006). Comparison on diet containing various fish meal levels on growth performance, body composition and Insulin-like growth factor -I of Juvenile channel catfish, (Icturulus panctatus) of different strains. Aquaculture, 253.628-635.

Longe, O.G. (1980). Effect of processing on the chemical composition and energy value of cassava. Nutr. Rept. Inter., 21: 819-829.

Njintang, N.Y., Mbofung, M.F., & Kesteloot, R. (2007). Multivariate analysis of the effect of drying method and particle size of flour on the instrumental texture characteristics of paste made from two varieties of taro flour. Journal of Food Engineering, 81: 250–256.

Olele, N.F. (2001). Comparative study on the use natural and artificial based diet on Clarias gariepinus fingerings. Journal of Agriculture and Biological, Science.6 9-13

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

Omoregie, E., & Ogbemudia, F.I. (1993). Effect of substituting fishmeal with palm kernel on growth and food utilization of the Nile Tilapia, (*Oreochromis niloticus*). Israeli J. Aquacult.; 43: 113 – 119.

Polsen, R.A., & Spencer, D.S.C. (1991). The technology adoption process in subsistence agriculture: The case for cassava in Southwestern Nig. Agri. Sys., 36: 65-78.

Rosling, H. (1987). Cassava toxicity and food security. Tryck Kontakt, Uppsala.

Shih, P.H., Yeh, C.T., & Yen, G.C.(2007) Anthocyanins Induce the Activation of Phase II Enzymes through the Antioxidant Response Element Pathway against Oxidative Stress Induced Apoptosis. Journal of Agricultural and Food Chemistry, **55**, 9427-9435.