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THE USE OF NOODLE WASTE AS A PARTIAL REPLACEMENT FOR MAIZE IN THE DIET OF TILAPIA (*Oreochromis niloticus*) FINGERLINGS

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Abstract

An 84 days study was conducted to investigate the effect of noodle waste as maize replacement on the growth performance, nutrient utilization and cost effectiveness in the diet of *Oreochromis niloticus* fingerlings. One hundred and fifty fingerlings of Tilapia with average weight of 12.02 ± 0.19 (Mean ± S.D) were distributed as 10 fish per plastic bowl (0.4m × 0.3m × 0.3m) in the wet laboratory. Five isonitrogenous experimental diets were formulated with noodle waste containing replacement of 0% (control) (D1), 25% (D2), 50% (D3), 75% (D4) and 100% (D5) as an energy source. The fingerlings were fed 5% body weight for 42days and 3% body weight for 42 days, the water was changed at every two day intervals. It was observed at the end of the experiment that noodle waste was most suitable when incorporated at 25% replacement. Weight gain (WG), Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), Protein Efficiency (PE) and carcass analysis were evaluated during this study. The total weight gain, specific growth rate, feed conversion ratio, protein efficiency values of 52.14 ±1.78, 0.20 ± 0.03, 1.95 ± 0.08 and 1.49±0.05 respectively were highest in fish fed diet D2. The final weights of the fish showed significant difference $P<0.05$ between fish fed various diets. There was significant difference ($P<0.05$) in FCR among the dietary treatment. D1 is not significantly different from D2. There was also significant difference in the SGR among the dietary treatment, though D1 and D2 has no significant difference ($P<0.05$), there was also significant difference ($P<0.05$) in the incidence of cost. The carcass protein also shows significant difference ($P<0.05$) with the control having the highest (40.5533 ± 0.01) and D1 having close value among the treatment diet (21.033 ±0.02) and same pattern followed for the fat, NFE, moisture content. Noodle waste can effectively replace maize at 50% level inclusion rate without any negative effect on growth and fish health, but, it is produce best result as 25% inclusion level as maize replacement as an energy source.

Keywords: Noodle-waste; Maize; *Oreochromis niloticus;* growth performance.

1. Introduction

Hunger and malnutrition are the world's most devastating problems and are inextricably linked to poverty. A total of 842 million people in 2011-13, or around one in eight people in the world, conduct an active life (FAO, IFAD WFP, 2013). For sustainable fish production from aquaculture, there is the need to reduce the cost of feed which presently contributes about 60% to total cost of fish production. This can be achieved through the use of non-conventional feed ingredients, which meets the criteria of relatively being cheap, available and easily accessible. The high competiveness between fish feed producers, other livestock feed producers and human has caused tremendous increase in the price of maize; a major feed ingredient in fish feed production. With the present production volume of about 600 million metric tons annually (Vasal, 2008), It is high in energy, low in fibre, with better palatability and presence of pigments and essential fatty acids, thus making it a preferred energy source in animal nutrition (Panda *et al*., 2011). However, the increasing cost and scarcity as a result of the various uses it is put to, has necessitated the need for utilization of other source of energy in fish feed production.

One of the advantages of fish culture is that it is aimed at the attainment of sustainable fish production at the minimum possible costs in the shortest possible time (Eruvbetine *et al,* 2002). This then necessitates research into non-conventional carbohydrate ingredients that will replace maize without compromising fish growth and health (Aderolu *et al.,* 2011). An ingredient with the potential to replace maize in fish feed is noodle - waste, generated from the packaging phase of instant noodles. Noodles' (produced from wheat flour, refined palm oil, salt, sodium polyphosphate, guargum, tartrazine) consumption has gained so much popularity worldwide (Reungmaneepaitoon *et al*., 2006), with Nigeria ranking 13th in world noodle consumption.

This study was conducted to determine the growth performance and economic benefits of *Oreochromis niloticus* fingerlings fed diets with graded levels of noodle-waste as a substitute for maize.

2. Materials and Methods

2.1. *Experimental diets*

The experimental diets consisted of isonitrogenous (36%) protein rations with the maize component replaced at five levels [0 (D1), 25 (D2), 50 (D3), 75 (D4) and 100% (D5)] by noodle waste.

The noodle waste with other feed ingredients were purchased at Kesmag and prepared at aqua-life farms, Olodo Road, Ibadan, Oyo State, Nigeria. The experimental ingredients include fish meal, groundnut cake, yellow maize, noodle waste, vitamin/mineral premix, soy bean meal, fish oil, salt, dicalcium phosphate (DCP) (Table 1). The diets were prepared in the form of pellets following the methods described by Wee and Ng (1986), oven-dried at 70°c in a gallenkamp oven for 18 hours, and stored in air-tight polythene bags kept in a deep freezer at a temperature of 8°C until used.

Table 1: Percentage composition of Ingredient for the experimental diets

	Diets				
Ingredient composition	DI	D2	D3	D4	D5
Fish meal	15.00	15.00	15.00	15.00	15.00
Soyabean meal	15.00	15.00	15.00	15.00	15.00
Groundnut cake	15.00	15.00	15.00	15.00	15.00
Yellow maize	48.00	36.00	24.00	12.00	
Noodle waste		12.00	24.00	36.00	48.00
DCP (Di Calcium Phosphate)	1.00	1.00	1.00	1.00	1.00
Fish oil	2.00	2.00	2.00	2.00	2.00
Vit. & min. premix	1.50	1.50	1.50	1.50	1.50
Salt	0.50	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50	0.50
Methionine	0.50	0.50	0.50	0.50	0.50
Starch	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00

2.2. *Experimental fish and feeding regime*

Healthy *Oreochromis niloticus* fingerlings of 6 weeks were procured from a reliable fish farm in Ibadan and transported in oxygen bags to the Research Laboratory of the Department of Aquaculture and Fisheries Management, University of Ibadan. After acclimatization in the Laboratory for 2 days, 10 fish were randomly weighed and stocked into each 40L plastic aquarium, with each treatment triplicated. The experimental diet was fed as assigned to triplicate aquaria and fed at 5% body weight at twice daily (8am & 5pm), for 84 days. Feed consumed daily were recorded, and bi-weekly weight of fish were used to adjust feed requirements. During bi-weekly growth measurement, a day feed deprivation was observed.

2.3. *Experimental tank*

The glass aquaria tank measuring 47 x 28 x 32cm were used for the experimental system. The tank water level was 18cm depth; the water source was from borehole. Complete drainage and cleaning of the tank was done twice a week to ensure good quality water.

2.4. *Experimental procedure*

Each of the experimental diet was assigned to a tank and fed to the fish twice daily in equal rations and were adjusted weekly on the basis of average weight of the fish. Each diet treatment *was* triplicated. Debris was siphoned from the experimental tanks daily and dead fish were counted, weighed and removed. The duration of the experimental study was 84 days.

All experimental diets and samples of fish carcass before and after the feeding trial were analyzed for their proximate composition according to methods of AOAC (2005).

Crude protein and crude lipid were determined using AOAC (2005). Fish growth and nutrient utilization parameters were calculated as follows: Specific growth rate (SGR), Food conversation ratio (FCR), Protein Efficiency Ratio (PER) Crude Protein Intake (g), and Feed intake, survival and incidence of cost

Specific growth rate (SGR) $SGR\ (\%/day) = \frac{(\text{Log } W_f - \text{Log } W_i) \times 100}{t\ (days)}$

Where, $\text{Log } W_f$ = logarithm of the fish final weight gain.

$\text{Log } W_i$ = logarithm of the fish initial weight.

t = experimental period in days

Feed conversion ratio (FCR) $FCR = \frac{\text{feed intake (g)}}{\text{Weight gain (g)}}$ (Burel *et al.,* 2000)

Gross feed conversion efficiency (GFCE): $GFCE = \frac{1 \times 100}{FCR}$

Protein efficiency ratio (PER) = $\frac{\text{wet body weight gain (g)}}{\text{Crude protein fed}}$

Protein intake = $\frac{\text{feed intake} \times \text{percentage protein in diet}}{100}$

Feed intake per week = $\frac{\text{Total feed intake per fish}}{\text{No of week of the experiment}}$

Mean Initial weight = $\frac{\text{Initial weight}}{\text{Number of fish}}$

Final weight = $\frac{\text{Final weight}}{\text{Number of fish}}$

Mean weight gain = Mean final weight – mean initial weight

2.5. *Chemical analysis*

At the beginning of the trial, 5 fish from initial stock and 6 fish per treatment at the end of the trial were pooled and analysed for whole body composition. Proximate analyses were carried out as described by A.O.A.C (2005).

2.6. Economic analysis

The cost of production of experimental fish was calculated as described by Mazid *et al* (1997) and Faturoti and Lawal (1986) as follows;

Profit Index (PI) = $\frac{\text{NPV (N)}}{\text{Cost of feeding (N)}}$

$$\text{Incidence of Cost} = \frac{\text{Cost of feeding}}{\text{Weight of fish produced}}$$

Where NPV is calculated as;

Net Production Value (NPV) = Mean Weight gain of fish (g) × Total survival (n) × Cost per kg (N)

2.6. *Data statistical analysis*

Data were subjected to one-way ANOVA as described by steel and torrie (1960). Each feed level was considered as a treatment and a complete randomized design (ANOVA) was carried out to test for significant difference in the mean weight gain at different level. Mean values were reported ± standard error of the mean (S.E.M). Multiple comparisons were done using Duncan Multiple Range Test. Significance was accepted at probabilities of 0.05 or less.

3. Result

The proximate composition of yellow maize and Noodle-waste are presented in Table 2. Percentage crude protein, ash and ether extract were higher (12.94, 6.38 and 5.97 respectively) in Noodle-waste, Crude fibre content was higher in yellow maize.

Table 2: Proximate Composition of Yellow Maize and Noodle Waste

	Ingredient	
Components (%)	Yellow Maize	Noodles
Dry Matter	90.38±0.00	92.30±0.00
Crude Protein	10.65±0.00	12.94±0.00
Crude Fibre	1.32±0.00	1.25±0.00
Ash	3.68±0.00	6.38±0.01
Ether Extract	4.09±0.00	5.97±0.06

The proximate composition of the experimental diets containing noodle waste at different inclusion level as shown in Table 3 showed Significant difference ($P<0.05$) between the diets on all the parameters, energy value ranged between 3695.04±0.52 (100% inclusion) to 3749.33±0.09 (25% inclusion), Protein ranged from 33.30±0.01 (50% inclusion) to 36.36±0.01 (0% inclusion), Fat content ranged from 7.36± 0.02 (100% inclusion) to 7.78±0.01 (50% inclusion), Ash ranged from 5.06±0.01 (100% inclusion) and 5.34±0.01 (0% inclusion), fibre ranged from 2.18±0.01 (75% inclusion) to 2.36±0.01 (0% inclusion), moisture ranged from 8.23±0.01 (25% inclusion) to 9.42±0.01 (100% inclusion). NFE was between 39.66±0.05 (0% inclusion) to 42.62±0.19 (50% inclusion). Energy was lowest in D5 and highest in D2. Protein was lowest in D3 and highest in D1. NFE was lowest in D1 and highest in D3. Moisture content was lowest in D2 and highest in D5. Fibre content was lowest in D4 (2.18±0.01) and highest in D1 (2.36±0.01), Ash was lowest in D5 (5.06±0.01) and highest in D1 (5.34±0.01) and fat content was lowest in D5 and highest in D3.

Table 3: Proximate composition of experimental diets fed to *Oreochromis niloticus*

Parameters	0%	25%	50%	75%	100%
Fat	7.4633±0.02[a]	7.6567±0.03[b]	7.7800±0.01[c]	7.533±0.02[d]	7.3633±0.02[e]
Ash	5.3400±0.01[a]	5.2800±0.01[b]	5.1800±0.01[c]	5.1500±0.01[d]	5.0600±0.01[e]
Fibre	2.3600±0.01[a]	2.2800±0.01[b]	2.433±0.01[c]	2.1800±0.01[d]	2.2600±0.01[e]
Moisture content	8.8533±0.01[a]	8.2300±0.01[b]	8.5767±0.01[c]	9.2633±0.01[d]	9.4233±0.01[e]
Nitrogen free extract	39.6633±0.05[a]	42.0767±0.05[b]	426267±0.19[c]	40.1100±0.04[d]	40.7567±0.04[e]
Protein	36.3567±0.01[a]	34.4767±0.01[b]	33.303±0.01[c]	35.8533±0.01[d]	35.0467±0.01[e]
Energy value	3710.9333±0.23[a]	3749.3333±0.90[b]	3740.8333±0.49[c]	3716.2000±0.79[d]	3695.0400±0.52[e]

The growth parameters tested as indicated in Table 4, shows that there was no significant difference (p<0.05) in the initial weight of the fish. There was significant difference (p < 0.05) in all the growth parameters tested for. The highest mean weight gain was recorded in D1 (6.74±0.30) though there was no significant difference (P<0.05) between the control, D2 and D3, the least value was recorded for D4 (3.42±0.17).

Table 4: Nutrient utilization and Growth performance of *Oreochromis niloticus* fed experimental diets (Mean ± SEM)

	DIETS				
PARAMETER	D1	D2	D3	D4	D5
Initial Weight(g)	11.92±0.00	11.9±0.00	11.92±0.00	12.02±0.01	12.02±0.01
Final Weight(g)	18.63±0.02[e]	18.59±0.0[d]	18.39±0.01[c]	17.94±0.01[b]	16.97±0.01[a]
Mean Weight Gain(g)	6.70±0.01[d]	6.69±0.00[d]	6.47±0.00[c]	5.92±0.00[b]	4.95±0.01[a]
Average Daily Weight Gain(g)	0.08±0.00[b]	0.08±0.00[b]	0.08±0.00[b]	0.0±0.00[ab]	0.06±0.00[a]
Specific Growth Ratio (SGR)	0.53±0.01[c]	0.53±0.01[c]	0.52±0.01[c]	0.47±0.01[b]	0.41±0.00[a]
Feed Conversion Ratio (FCR)	1.06±0.00[a]	1.07±0.00[ab]	1.07±0.00[ab]	1.22±0.00[c]	1.41±0.01[d]
Protein Efficiency Ratio (PER)	2.75±0.00[d]	2.74±0.00[cd]	2.73±0.00[c]	2.41±0.00[b]	2.08±0.01[a]
Feed Intake (g)	7.15±0.00[d]	7.13±0.00[c]	7.23±0.01[e]	6.93±0.01[a]	6.98±0.00[b]
Survival Rate (%)	97.66±0.33[c]	97.00±0.57[c]	94.66±2.84[bc]	91.00±0.57[ab]	90.00±0.57[a]
Profit index (PI)	0.81[e]	0.79[d]	0.75[c]	0.69[b]	0.56[a]
Incidence of cost (IC)	0.48[a]	0.47[a]	0.50[b]	0.52[c]	0.63[d]

Mean with similar superscript along same row are not significantly different (P<0.05)

In Specific Growth Rate parameter, the data shows that the highest values were D1 (control), D2 and D3, these values are significantly difference (p<0.05) from D4 and D5 with the least values. In the specific growth rate control, D2 and D3 are significantly different from D4 and D5 with control having the highest followed D2 while the least was D5. In the food conversion ratio growth parameters observed that the D1 (control) had the best (1.7 ± 0.08) followed by D2 (1.95 ± 0.08) with no significance difference (p<0.05) while D3, D4 and D5 had no significance difference, D5 has the least value. The protein intake shows no in significance difference (p<0.05) in all the experimental diets. The protein efficiency showed that D1 is the highest with significant difference (p<0.05) from D2 that is higher and significantly difference (p<0.05) from D3 while D4 and D5 are the least with no significance difference. The survival ratio had no mortality in D1 (0.00 ± 0.00) and has significantly difference to D2 (3.33 ± 5.77), with significance difference to D3 and also significantly difference to D4 and D5. Though, the incidence of cost is highest in D1 followed by D2 and least in D5 they are all significantly different (p<0.05). Profitability index was significantly decreased with inclusion of noodle waste in the diets of O. niloticus. However, the Incidence of cost was statistically similar in D1 and D2, with both treatments having superior indices than the other groups. The proximate analysis of the carcass revealed that the fibre has no significance difference at ($p<0.05$) in all the treatment but are significantly difference ($p<0.05$) in the crude protein, fat and ash content, with no wide margins between the control and other treatment as shown in Table 5.

Water quality parameters in the bowls during the experimental period are presented in Table 6. The values observed were within the tolerant range of *O. niloticus*. The pH was between 7.18 to 70.25, Dissolved Oxygen 6.7 – 7.6 Mg/Litre and Temperature was between 28.30 – 29.20 ^{O}C.

Table 5: carcass composition of *Oreochromis niloticus* fed experimental diets

Parameter (%)	D1	D2	D3	D4	D5
Crude protein	21.033±0.02^{d}	20.7500±0.01^{c}	20.6800±0.01^{b}	20.4967±0.01^{a}	20.4833±0.01^{a}
Fat	3.7833±0.01^{b}	3.9667±0.01^{d}	3.8633±0.02^{c}	3.8000±0.01^{b}	3.7433±0.01^{a}
Ash	2.16±0.01^{e}	2.08±0.01^{c}	2.05±0.01^{a}	2.10±0.01^{d}	2.07±0.01^{b}
Fibre	0.30±0.00^{a}	0.35±0.00^{a}	0.30±0.00^{a}	0.30±0.00^{a}	0.30±0.00^{a}

Table 6: Pooled mean weekly values of water quality parameters during the experimental study

Treatment	Parameter		
	DO (mg/l)	pH	Temp ^{O}C
Initial	7.50	7.18	28.50
D1	7.20	7.19	28.70
D2	7.40	7.21	28.30
D3	7.14	7.18	29.10
D4	7.40	7.20	28.10
D5	7.00	7.19	28.50

4. Discussion

The crude protein, lipid and ash contents for maize and noodle waste in this study are similar to values reported for cereal grains and by-products (Hassan, 2000). The crude protein content of experimental diets is within the recommended range for *O. niloticus* (Wang *et al.*, 1985). Mean weight gain in the control diet confirms the assertion that maize is a preferred source of energy in fish diets (Panda *et al.*, 2011). This is attributable to the high digestibility and better palatability of maize. Improved nutrient utilization and growth performance at high levels of maize inclusion by *O. niloticus* is similar to results observed by Solomon *et al.,* (2007). Ingredient mix may compromise these attributes of palatability and digestibility in fish, as shown in noodle waste inclusion levels above 50% where growth depression was observed. The variation in mix is largely responsible for this result. This assertion is supported by Li *et al*. (2010) and Orisasona *et al.* (2014) for different fish species. Although no dietary requirement for carbohydrate has been demonstrated in fish diet (NRC, 1983), the provision of adequate level in diet is necessary so that protein and lipids will not be catabolized mainly for energy and synthesis of other biological compounds (Shiau and Huang, 1990; Wilson, 1994).

The present SGR values are comparable to those values of the tested various dietary carbohydrate levels on *Mystus montanus.* (Tian *et al.,* 2010). One of the most common difficulties observed when alternative sources of feedstuffs are used in fish diets is acceptance and palatability (Dominguez *et al.*, 2003). However, the observed significant decrease in feed intake above 50% inclusion level, showed the better palatability of maize when compared with noodle waste.

It is important to note the presence of various additives contained in noodle waste (Including Sodium polyphosphate, guar gum and tartazine) could possibly have affected the utilization of protein as evident in the reduced carcass protein of experimental fish at higher inclusion levels. The results of carcass composition in this study are in accordance with the growth performance results. The variation in maize and noodle waste contents resulted in significant differences ($P<0.05$) in the proximate composition of fish carcass in this study. This is in contrast to the reports of Anderson *et al*. (1984) and Al-Asgah and Alli (1994) where cereal grain types did not affect the crude protein and ash contents of *O. niloticus*.

This study has revealed that noodle-waste can only replace up to 50% of maize in the diet of *O. niloticus* without compromising nutrient utilization and growth performance of fish.

References

Aderolu, A. Z., Aarode, O.O. and Adigun A. (2011) Replacement of maize with graded levels of noodle waste in commercial diet of African catfish*.* *Nigerian Journal of Fisheries* Vol. 8 (2) 2011.

Al-Asgah, N.A. and Alli, A. (1994) Feeding of various carbohydrate sources on the growth performance and nutrient utilization in *Oreochromis niloticus.* Agribiol. Res., 47: 1-12.

Anderson, J., Jackson, A.J., Matty, A.J. and Capper, B.S. (1984). Effect of dietary carbohydrate and fibre on the tilapia *Oreochromis niloticus* (L). Aquaculture, 37: 303-314.

A.O.A.C (2005) Association of Official Analytical Chemists: Official Methods of Analysis, 17th edition. Washington, DC, USA.

Burel, C., T. Boujard, F., Tulli, and Kaushik,S. J. (2000). Digestibility of extruded pea, extruded lupin and rapeseed meals in rainbow trout (Oncorhynchus mykiss) and turbot (Psetta maxissa). *Aquaculture 188: 285 -298.*

Domingues P., Sykes N.O, Sommerfield A. and Andrade,J. P. (2003). Effects of feeding live or frozen prey on growth, survival and the life cycle of the cuttle fish, *Sepia officinalis*(Lin. 1758). *Aquacult.Internat.*11: 397-410.

Eruvbeline, D., Dipeolu, M. A., and Oguntona, E. B. (2002): Comparism of enzyme and antibodies inclusion in diets for laying hens. Proc .27th ANN. NSAP Confrence, 17-21 March, 2002. Akure. Nigeria pp 101-104

FAO, IFAD and WFP (2013).The State of Food Insecurity in the World 2013.The Multiple Dimension of Food Security: FAO Fisheries and Aquaculture Department. 2pp.

Faturoti, E.O and Lawal, L.A. (1986). Performance of Supplementary Feeding and organic manuring on the production of *O. niloticus. Journal of West African Fisheries. 1:25-32.*

Hassan, M.R. (2000) Nutrition and feeding for sustainable aquaculture development in the third millennium. In: Subasinghe, R.P., Bueno, P., Phillips, M.J., Hough, C., McGladdery, S.E. and Arthur, J.R., (Eds.) Technical Proceedings of the Conference on Aquaculture in the Third Millennium, 20-25 February 2000, Bangkok, Thailand, Bangkok /Rome: NACA/FAO

Li, H.M., Robinson, E.H., Bosworth, B., Oberle, D. F., and Lucas, P.M. (2011). Effects of varying dietary compositions using common feed ingredients on growth and feed efficiency of pond-raised Channel Catfish I*ctalurus punctatus* (Rafinesque). *Aquaculture Research* 41: 1133-1139

Mazid, M. A., Zaher, M., Begun, N.N, Aliu, M. Z., Nahar, F. (1997). Formulation of Cost Effective Feeds from locally available ingredients for Carp culture system for increase production. Aquaculture, 151:7-78.

NRC (1993). Nutrient Requirements of Fish. National Academy Press,Washington, DC, USA.

Orisasona O, Falaye, A.E. and Ajani E.K. (2014) Effect of replacement of Soya Bean Meal with Lima Bean Meal on the Growth and Heamatological parameters of C. *gariepinus* fingerlings

(Burchell 1822) In Press: *Israeli journal of Aquaculture*- Bamidgeh

Panda, A.K., Raju, M.V., Rama, L.N., Rao, S.V., Lavanya, G., Pradeep Kumar Reddy,E., Shyam Reungmaneepaitoon, S.,Sikkhamondhol,C., and Tianpook,C. (2006). Nutritive improvement of instant fried noodles with oat bran.*Sungklanakarin J. Sci. Technol.*, 8(1): 89-97.

Shiau, S.Y. and Huang, S. L. (1990). Influence of varying energy levels with two protein concentrations in diets for hybrid tilapia (*Oreochromis niloticus* x *O. aureus)* reared in sea water. Aquaculture, 91: 143-152.

Solomon, S.G., Tiamiyu, L.O. and Agaba, U.J. (2007): Effect of Feeding Different Grain Sources on the Growth Performance and Body Composition of Tilapia, (*Oreochromis niloticus*) Fingerlings Fed in Outdoor Hapas. Pakistan Journal of Nutrition 6(3): 271-275

Steel, R.G.D. and Torrie, J.H. (1960).Principles and Procedures of statistics, with special references to biological sciences [by] Robert Steel, G.D [and] James Torrie, H. New York, McGraw-Hill.

Sunder, G. (2011). Nutritional evaluation and utilisation of quality protein maize, Nityashree hybrid maize, and normal maize in broiler chickens. British Poultry Science Volume 52, Number 5 (October 2011), pp. 632—638

Tian, L.X., Liu, Y.J. , Hung, S. S., Deng, D.F., Yang, H.J., Niu, J. and Liang, G.Y. (2010).Effect of feeding strategy and carbohydrate source on carbohydrate utilization by Grass Carp (*Ctenopharyngodon idella*).*American Journal of Agriculture and Biological Sciences.*5 (2): 135-142.

Vasal, S.K. (2008) Global efforts on improving quality protein maize. Proceedings of the National Symposium on Quality Protein for Human Nutritional Security and Development of Poultry Sector in India. NASS complex, New Delhi

Wang, K., Takeuchi, T. and Watanabe, T. (1985) Effect of dietary protein levels on growth of Tilapia nilotica. Bull. Jap. Soc. Sci. Fish., 51: 133-140.

Wee, K. C. and Ng, L.T. (1986) Use of cassava as energy source in pelleted feed for the tilapia, *Oreochromis niloticus L. Aquaculture Fish Management* 17: 129-138.

Wilson, R.P. (1994). Utilization of dietary carbohydrate by fish. *Aquaculture,* 124:67-80.