AJAB

Asian J Agri & Biol. 2017;5(4):158-164.

Original Research Article

Effect of natural antioxidants on the growth and proximate composition of common carp (*Cyprinus carpio*)

Arslan Emmanuel, Kalim Ullah, Ruqia Mehmood, M. Zubair Anjum*

Department of Zoology and Biology, Faculty of Sciences, PMAS-Arid Agriculture University Rawalpindi, Pakistan.

Received:
February 23, 2017

Accepted:
August 23, 2017

Published:
December 17, 2017

**Corresponding author email:*
zubair.anjum@uaar.edu.pk

Abstract

A 60 days growth experiment was conducted on common carp (*Cyprinus carpio*) fingerlings fed with different diets having natural antioxidants i.e., vitamin A, vitamin E & commercially available vitamin premix as control. Growth parameters and meat analysis was performed to evaluate the effect of antioxidants on growth and meat quality of common carp. The highest weight gain (14.69 ± 2.03 g) was observed by the fingerling fed with diet having vitamin E followed by vitamin premix (13± 1.67 g) and vitamin A (8.99 ± 1.07 g). Maximum increase (15.03 ± 0.18 cm) in length was recorded in fingerlings fed with diet having vitamin A followed by vitamin E (12.74 ± 0.47 cm) and vitamin premix (12.68 ± 0.77 cm). After feeding trial, random samples of ten fingerlings were collected from each aquarium fed with diets having different antioxidants for meat analysis. Moisture percentage (77.5%) and total fats (18.5%) were higher in fish meat fed with vitamin A. Crude protein (60.7%) and carbohydrates (56.3%) were higher in fish fed with vitamin E and the highest percentage of dry mater (22.8%) and total ash (0.23%) were recorded with vitamin premix diet. Dry matter, moisture, crude protein, total fat and carbohydrate were significantly different while total ash shows non-significance results for different antioxidants. The results of current study showed that vitamin E has positive effect on growth and meat quality of common carp.

Keywords: Antioxidants, Vitamins, Common carp, Fish Growth, Proximate composition

Introduction

Fish is the crucial part of human diet. It contains considerable amount of all important amino acids and minerals specifically phosphorus, copper, iodine, potassium, and vitamins A and D (Sandhu, 2005). The contribution of fish meal containing low carbohydrate and unsaturated fats, especially omega 3 contents in human diet can improve the human health. As the world's population growing tremendously, demand for food is also increasing. With increase of food quantity, its quality must also be considered (Salim, 2006). Many factors determine meat quality which includes freedom from micro-biological hazards, taste and eating quality especially the amount and type of fats. Science and technology has enabled the meat industry to improve consumer perception, particularly in term of quality, safety and product stability (Tory et al., 2010).

Human desire of being healthy shifted their dietary habits for protein source from red meat to fish meat (Salim, 2006). From the last few years a lot of work had been done on fish meat and its products to improve health aspects by using functional compounds like

vitamin E, conjugated linoneleic acid, n3 fatty acids and selenium in animal nutrition to improve carcass composition and meat freshness caliber in animals (Wangang et al., 2010). Fish is a good source of essential minerals, vitamins A, calcium, iron and zinc (Roos, 2002).

Oxidative stress on meat affects the meat quality such as tissues disintegration, decomposition, loss of phenolic subjects and minerals, boost free radicals and melon aldehydes production which lessens the antioxidant action of flesh and its supplements. Muscles auto-oxidation is liable to cause reactive oxygen species production in animal tissues and may cause serious health issues (Mandal, 2013). Man-made antioxidants like butylated hydroxytoluene and butylated hydroxyanisole are one of the effective tools to get rid of oxidation troubles in meat supplements. Although, natural antioxidants utilization are proved much safer as compared to synthetic antioxidants. Consequently, natural antioxidants utilization trend in meat supplements is enhancing (Brannan, 2008). Antioxidants are used as feed supplement for increasing oxidative endurance in meat because they delay or diminish oxidation of lipids by reducing the free radicals formation in fish meat (Roginsky and Lissi, 2005). Ever since different types of antioxidants present and each antioxidant have its own protective role towards oxidation. The antioxidant has significant capability than the amount of a single compound (Sacchetti et al., 2008). Damage caused by oxidation of a muscle can be recovered by addition of antioxidants in meat. It enhances the worth and sustainability of meat and meat products.

The proximate composition of fish species is different among the fish species. The food type of the fish is important for the quality and quantity of the fillet nutrients. Estimation of proximate composition such as protein, fats and ash is often necessary to ensure that they meet the dietary requirements and commercial specifications (Watchman, 2000). Fish is also very important for health since it comprises good contents of moisture, protein, lipids, vitamins, minerals and energy source (Steffens, 2006). In addition to nutritional value, fish is also a good source of income. Antioxidants are proficient in inactivating the free radicals prior they attack cells. Antioxidants are vital elements for favorable cellular and systemic health maintenance (Percival, 1998). Most common nutritious antioxidants are vitamin C, vitamin E and beta carotene. In extracellular fluids, vitamin C is viewed as the essential water-soluble antioxidant.

In the view of previous findings, present feeding experiment was conducted to evaluate the requirement of different antioxidants for common carp in relation to growth performance and to assess the relationship between growth and meat quality of fish.

Materials and Methods

A 60 days feeding trail was conducted on common carp (*C. carpio*) in aquaria at Aquaculture and Fisheries Laboratory, Department of Zoology & Biology, Pir Mehr Ali Shah, Arid Agriculture University Rawalpindi, Pakistan in 2016. Six aquaria having dimensions of 2 × 1 ×1.5 feet (length × width × height) filled with equal amount of tap water were stocked with 90 common carp fingerlings, 15 in each. Initial growth parameters were taken to maintaining the quantity of supplementary feed. Fish were fed with three different diets (one diet in two aquaria) at the rate of 5% wet body weight of fish. Diet 1 contains vitamin A (5400 IU/kg), diet 2 vitamin E (131 mg/kg) and diet 3 with a mixture of vitamins A, C & E (2500IU/kg, 33 mg/kg & 33mg/kg) as supplement with normal fish diet having 30% crude protein. The composition and ingredients of the basal diet are given in Table 1.

Table - 1: Composition of fish diet

Ingredients	Percentage
Fish meal	30%
Soybean meal	13%
Sunflower meal	5%
Canola seed meal	5%
Rice polishing	17%
Gluten 30 %	13%
Wheat bran	13%
Soybean oil	2%
Vitamin	2%

Excessive food and feces were removed periodically as desired to maintain the healthy environment for fish growth. Aeration of water was done by using aquarium pumps. After feeding trail the fish were taken out for final growth measurements and composite analysis of meat to evaluate the effect of different antioxidants on growth performance and meat quality. Proximate body composition in terms of moisture content, crude protein, fats, ash and carbohydrates was done by using standard techniques (AOAC, 1990). Data of growth and composite composition was subjected to statistical

analysis i.e., the arithmetic means (±SD) for weight in different groups has been calculated. Furthermore, analysis for meat quality has been done using analysis of variance (ANOVA) technique (Steel and Torrie, 1980). The level of significance was P<0.05 and the data used in the form of arithmetic means (±SD).

Results

There was no significant (p>0.05) effect of different vitamin contacting diets on weight increase of common carp. The highest weight gain (14.69 gm) was obtained with diet containing vitamin E (Table 3). The increase in length was observed significantly higher (15.03 cm) in fish fed with diet containing vitamin A as compared to other two diets containing vitamin E and vitamin premix respectively (Table 4).

Proximate analysis of fish meat fed by diets containing different antioxidants was done and the analysis of variance showed the significant difference (p<0.05) for dry matter and moisture contents. Minimum and maximum values of dry matter were noted as 15% and 22.8% in fish meat fed with vitamin A and vitamin premix (Fig. 1a) while minimum and maximum values for moisture contents were observed 68% and 77.5% when fish fed with vitamin A and vitamin E, respectively (Fig. 1b). Results of Duncan's Multiple Test for dry matter and moisture contents showed that diet containing vitamin A was significantly different from diet containing vitamin E and vitamin premix (Table 2).

The analysis of variance showed that all three diets containing vitamin A, vitamin E and vitamin premix was significantly different from each other (p<0.05) for crude protein, total fats and carbohydrates. The minimum and maximum values of crude protein were noted as 45.91% and 60.75% in vitamin premix and vitamin E (Table 2, fig. 1c), minimum and maximum values for total fats was 15.75 % and 18.54 % in vitamin premix and vitamin A (Table 2, fig. 1d). Minimum and maximum values of carbohydrates were 39.13 % and 56.33 % in vitamin premix and vitamin E respectively (Table 2, Fig. 1f) and results of crude protein, total fats and carbohydrates shows that all three diets containing vitamin A, vitamin E and vitamin premix were significantly different from each other. Total ash were noted as 0.17%, 0.16 % and 0.23 % in fish fed with diet containing vitamin A, vitamin E and vitamin premix respectively (Table 2, Fig. 1e) and results of Duncan test for total ash shows that all three diets containing vitamin A, vitamin E and vitamin premix were non-significantly different from each other.

Table - 2: Proximate composition of fish meat

Diets	Dry matter	Moisture	Crude Protein	Total Fats	Total Ash	Carbohydrates
Vitamin A	15[a]	68[a]	54.66[a]	18.54[a]	0.17[a]	41.43[a]
Vitamin E	22.15[b]	77.53[b]	60.75[b]	17.62[b]	0.16[a]	56.33[b]
Vitamin premix	22.81[b]	77.13[b]	45.91[c]	15.75[c]	0.23[a]	39.13[c]

* Numbers containing same alphabets are significantly similar

Table - 3: Average body weight (gm) of the fish fed by different diets

Weight Gain (gm)	Vitamin A	Vitamin E	Vitamin premix
Before treatment	11.2±0.61[a]	10.61±0.95[a]	9.4±0.905[a]
After treatment	20.19±0.459	25.3±1.077	22.4±0.765
Weight gain	8.99±1.069	14.69±2.027	13±1.67
Weight Gain (%)	44.52	58.06	58.03

*p>0.05

Table - 4: Average total length (cm) of the fish fed by different diets

Length (cm)	Vitamin A	Vitamin E	Vitamin premix
Before treatment	9.62±0.34[a]	10.02±0.45[b]	9.96±0.79[b]
After treatment	15.03±0.184	12.74±0.467	12.68±0.766
Length increase	5.41±0.524	2.75±0.917	2.72±1.556
Length increase (%)	35.99	21.35	21.45

*P<0.05

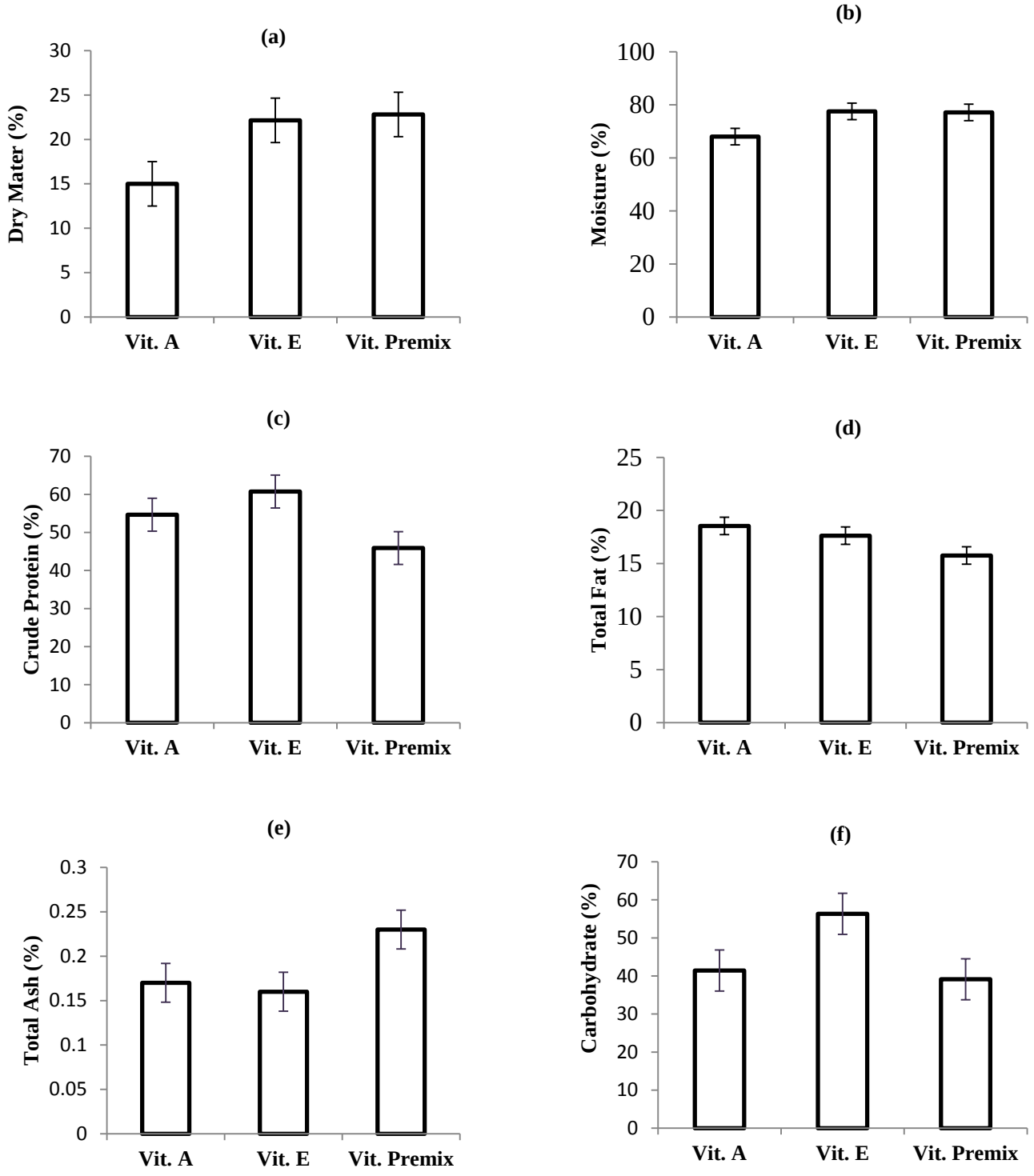

Fig. 1: Effects of dietary vitamins on proximate meat analysis.

Discussion

Mehrad et al. (2010) and James et al. (2008) showed increase body weight of zebra fish and gold fish supplementing with vitamin E respectively and it also enhance fecundity. In favor with the previous research fish fed with diet containing vitamin E shows effective weight gain as compare to diets containing vitamin A and vitamin mixture for common carp.

Vitamin A was the important hormonal metabolite which is essential for growth and differentiation of epithelial cells it store in liver so growth of fish increase with diet containing vitamin A (Halver, 2002). Experiment carried out of vitamin A, E and C on *Litopenaeus vannamei* by Darvishpour et al. (2012) shows increase in total length with vitamin A containing diet while weight gain was observed higher in fish fed with vitamin E diet which support the results of present study for *C. carpio*. Fish diet containing vitamin premix as a control shows non-significant results in terms of weight gain and increase in body length of common carp.

Percentage range of the moisture contents of fish muscle should be within the range of 60-80% (Adewumi et al. 2014) which was observed in all sampled fish of present study fed with different diets containing antioxidants. Moisture content in Mackerel and Herring were observed 65.0% and 68.6% respectively (Olangunju et al. 2012). The minimum and maximum values of moisture contents (68% and 77.53%) were in acceptable range shows good indicator of relative content of energy, protein and lipid.

Percentage of crude protein varies from 15.3% to 16.32% in Nile tilapia collected from Lake Hashenge and Tekeze reservoir which may be due to the diet composition of the fish (Tsegay, 2016). Shimma (1986) observed non-significant distinction of protein and moisture in the *C. carpio* and Mirror carp, fed at a similar level of commercial feed. Srikanth et al. (1989) reported highest protein content in *C. carpio* with the application of fertilization along with protein diet. In line with the previous work high content of crude protein (60.75%) were observed with diet containing vitamin E.

In all the three different treatments, the percentage of fats in meat sample of experimental fish was significantly different ($p<0.05$) from each other. As indicated by Ackman (1989), that fish can be divided into four groups on the basis of their fat substance: low fat (< 2 to 4 %), medium fat (4 to 8%) and high fat (> 8%). Zuraini et al. (2006) observed high fat contents up to 11.9% for *Channa striatus* while Ama-Abasi and Ogar (2013) noted 17.3% of fats in *Parachanna obscura*. The high concentration of lipids makes fish a very good healing agent for post-operation patients (Mat Jais et al., 1998). Therefore, in favor to previous research the fish fed with diet containing vitamin A in present study shows the best results in term of high lipid concentration of 18.54% in common carp.

Ash is a measure of the mineral substance of food item such as Na, Ca, K, Zn, Fe, Mg, Mn and Cu. It is the inorganic residue that remains after the organic matter has been blazed off (Adewumi et al., 2014). The maximum ash concentration (0.23%) observed in fish fed with control diet having vitamin premix shows better results in *C. carpio* for mineral deposits.

Carbohydrates are sources of instant energy, which can be used in the body development and growth (Olagunju et al., 2012). Fish mostly have low levels of carbohydrates (USDA 2010). The glycogen does not contribute much to the stores in the fish body tissue resuling is low carbohydrates value but few species also showed higher values (Jayasree et al., 1994; Das and Sahu 2001). Low carbohydrates level was observed in fish fed with diet having vitamin premix followed by vitamin A and vitamin E.

Present study of proximate analysis of common carp meat concluded that diets containing different antioxidants can cause variation in moisture contents, crude protein, total fats, total ash and carbohydrates. High level of crude protein was observed in fish fed with diet containing Vitamin E while the low fat concentration was observed with commercially available vitamin premix diet. This study provides update information for fish feed composition in terms of antioxidant usage as well as a source of information for fish farmer to produce quality fish meat.

References

Ackman RG, 1989. Nutritional composition of fats in sea foods. Prog. Food Nutr. Sci. 13:161-241.

Adewumi AA, Adewole HA and Olaleye VF, 2014. Proximate and elemental composition of the fillets of some fish species in Osinmo reservoir, Nigeria. Agric. Boil. J.N.A. 5:109-117.

Ama-Abasi D and Ogar A, 2013. Proximate analysis of snakehead fish *Parachanna obscura* (Gunther 1861) of the cross river, Nigeria. J. Fish. Aqua. Sci. 8:295-298.

AOAC, 1990. Official Methods of analysis of Association of Official Analytical Chemists International. 17th Ed., Washington, US.

Brannan RG, 2008. Effect of grape seed extract on physicochemical properties of ground salted chicken thigh meat during refrigerated storage at different relative humidity levels. J. Food Sci. 73:36-39.

Darvishpour H, Yahyavi M, Mohammadizadeh F and Javadzadeh M, 2012. Effects of vitamins A, C, E and their combination on growth and survival of *Litopenaeus vannamei* post larvae. Adv. Stud. Biol. 4:245–253.

Das S and Sahu BK, 2001. Biochemical composition and calorific content of fishes and shellfishes from Rushikulya estuary, south Orissa coast of India. Indian J. Fish. 48:297-302.

Halver JE, 2002. The vitamins. Fish Nutrition (Ed. J. E. Halverand R. W. Hardy) pp. 61-141. Academic Press, San Diego, California, USA

James R, Vasudhevan I and Sampath K, 2008. Effect of Dietary Vitamin E on Growth, Fecundity, and Leukocyte Count in Goldfish (*Carassius auratus*). Israeli J. Aquac. Bamidgeh. 60(2): 121-127.

Jayasree V, Panilekar AH, Wahidulla S and Kamat SY, 1994. Seasonal changes in biochemical composition of *Holothuria leucospilota* (Echhinodermata). Indian J. Marine Sci. 232: 117-119.

Mandal A, 2013. What are antioxidants? Life sciences and medicine. https://www.news-medical.net/health/What-are-Antioxidants.aspx accessed on 13 Aug 2017.

MatJais AM, Matori MF, Kittakoop P and Suwanborirux K, 1998. Fatty acid compositions in mucus and roe of Haruan, *Channa striatus*, for wound healing. Genetic. Pharmacol. 30: 561-563.

Mehrad B and Sudagar M, 2010. Dietary vitamin E requirement, fish performance and reproduction of guppy (*Poecilia reticulata*). AACL Bioflux. 3(3): 239-246.

Olagunju A, Muhammad A, Mada SB, Mohammed A, Mohammed HM and Mahmoud KT, 2012. Nutrient Composition of Tilapia zilli, Hemisynodontis membranacea, Clupea harengus and Scomber Scombrus Locally Consumed in Africa. World. J. Life Sci. Med. Res. 2:16 – 19.

Percival M, 1998. Antioxidant. Clinic. Nutr. Insight. NUT0311(96).

Roginsky V and Lissi EA, 2005. Review of methods to determine chain-breaking antioxidant activity in food. Food Chem. 92: 235-254.

Roos N, Jakobsen TLJ and Thilsted SH, 2002. High vitamin A content in some small indigenous fish species in Bangladesh: perspectives for food-based strategies to reduce vitamin A deficiency. Int. J. Food Sci. Nutr. 53(5): 425-437.

Sacchetti G, Cocci E, Pinnavaia GG, Mastrocola D and Dalla Rosa M, 2008. Influence of processing and storage on the antioxidant activity of apple derivatives. Int. J. Food Sci. Tech. 43: 797-804.

Salim M, 2006. Role of fish as food to human nutrition. International conference on "Solving problems of Freshwater Fish Farming in Pakistan" November 27-28, 2006. UVAS, Lahore. p. 20.

Sandhu GS, 2005. A textbook of fish and fisheries. Dominant publishers and distributors, New Delhi. pp. 39-40.

Shimma H, 1986. Growth and proximate composition of two races, Yamato and Mirror of carp, *Cyprinus carpio*. Bull. Natl. Res. Inst. Aquacul. 9: 15-20.

Srikanth GN, Nadeesha MC, Keshvanath P, Varghese TJ, Shetty HPC and Basavaraja N, 1989. On the applicability of a mixed feeding schedule for common carp *Cyprinus carpio* var. *Communis*. In: Proceedings of the Asian Seminar on Aquaculture (eds. E.A. Huisman, N. Zoonneveled and A.H. Boumans). Malang, Indonesia, 14-18 November, 1988.

Steel RGD and Torrie JH, 1980. Principles and Procedures of Statistics. 2nd ed. McGraw-Hill. New York, USA.

Steffens W, 2006. Freshwater fish- wholesome food stuffs. Bulg. J Agric. Sci. 12: 320-328.

Troy DJ and Kerry JP, 2010. Consumer perception and the role of science in the meat industry. Meat Sci. 86: 214-216.

Tsegay T, Natarajan P and Zelealem T, 2016. Analysis of diet and biochemical composition of Nile Tilapia (*O. niloticus*) from Tekeze reservoir and Lake Hashenge, Ethiopia. J. Fisheries Livestock Prod. 4:2.

USDA, 2010. US Department of Agriculture, Agricultural Research Service, National Nutrient Database for standard reference, Release 23. Nutrient laboratory.

Wangang Z, Shan X and Samaraweera H, 2010. Improving functional value of meat products. Meat Sci. 86: 15-31.

Watchman JJ, 2000. Composition and Quality of fish, Edinburgh, Torry Research Station.

Zuraini A, Somchi MN, Solihah MH, Goh YM and Arifah AK, 2006. Fatty acid and amino acid composition of three local Malaysian *Channa* spp. fish. Food Chem. 97: 674-678.