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Nutritive Value of Nile Tilapia (*Oreochromis niloticus*) Cultured in Different Pond Systems, Gezira State, Sudan

Omer A Idam [1*], Sara G Elsheakh [2], Fatima S Abdalla [3], Esmat A Drag [4]
[1, 3] Department of Fish Production and Technology, Faculty of Animal Production, University of Gezira, Wad medani, Sudan
[2] Department of Fish resources, Ministry of Animal Resources and Fisheries, Gezira State, Wad Madani, Sudan
[4] Faculty of Animal Production, University of Gezira, Wad Medani, Sudan

* Corresponding Author: **Omer A Idam**

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Abstract
Fish has an important role in food security and poverty alleviation in both rural and urban areas of Sudan, but little is known about the nutritive value of the Nile fish that are normally utilized either fresh or preserved dried, salted or smoked. The study was conducted to evaluate nutritive value of nile tilapia (*Oreochromis niloticus*) cultured in earthen ponds compared with concrete ponds in fish farms in Gezira State, Sudan. A total of 36 samples of nile tilapia (*Oreochromis niloticus*) were collected from earthen and concrete ponds fish farms around Gezira State and the samples were subjected to chemical analysis (moisture, dry matter, ash, crude protein, fat, and crude fibre). The data was subjected to SPSS by using completely randomized design (CRD). The findings of this study revealed that, *Oreochromis niloticus* from concrete ponds has higher level of nutritive value than earthen ponds farms except fibre contents is higher in earthen ponds farms than concrete ponds farms, and there was highly significant difference ($P \leq 0.01$). In nutritive value of Fish between two types of ponds system, except crude fibre is recorded significant difference at ($P \leq 0.05$) between two ponds culture system. According to the findings, we recommended that: Encouragements and attention should be paid to aquaculture sector in order to shift fish production gradually from fisheries sector to aquaculture systems.

Keywords: Nile tilapia, Gezira State, nutritive value

Introduction
Most developing countries are located in tropical or sub-tropical areas, and fish is a vital component of food security for these countries. Rivers and lakes in these countries are more accessible and kinder sources of fish, and also carry over 40% of the world's known fish species (Zenebe *et al*., 1998a) [14]. Moreover, the production and consumption of freshwater fish has increased during recent years. Therefore effort is needed to improve the output performances and quality of the most important tropical freshwater fish.
Fish has an important role in food security and poverty alleviation in both rural and urban areas of Sudan. However, a little is known about the nutritional value of the Nile fish that are normally utilized either fresh or preserved dried, salted or smoked. Better knowledge of their nutritional value, which is expected to be closely associated with fish species, could contribute to the understanding of variability in meat quality of different species of the Nile fish. Moreover, the measurement of some proximate profiles such as protein contents, lipids and moisture contents is often necessary to ensure that they meet the requirements of food regulations and commercial specifications (Waterman, 2000) [12].
The production of Tilapia worldwide is being intensified, mainly due to the decline in marine fisheries and to the quality of its meat. Tilapia is suitable for intensive farming and trade. It has characteristics preferred by the market, such as white meat, firm texture, delicate taste, easy filleting, no "Y" – shaped bones, in addition to productive characteristics suitable for breeding: high growth rate and adaptability to different conditions (Jory *et al*., 2000) [8].

Water is the culture environment for fish and other aquatic organisms. It is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion (Bronmark and Hansson, 2005) [1]. Based on this, access to adequate, regular and constant supply of good quality water is vital in any aquaculture project. According to Sikoki and Veen (2004) [1]0, any water body is a potential medium for the production of aquatic organisms. Water quality parameters can be divided into three main categories: physical (density, temperature); chemical (pH, conductivity, nutrients) and biological (bacteria, plankton and parasites) (Delince, 1992) [3]. All living organisms have tolerable limits of water quality parameters in which they perform optimally. A sharp drop or an increase within these limits has adverse effects on their body functions (Davenport, 1993) [2].

The intensive farming of tilapia, *Oreochromis sp*. is rapidly expanding and tilapias (including all species) are the second most widely farmed fish in the world with annual production exceeding two million tons in 2005 (FAO, 2007) [4]. China produces almost half of the worlds' tilapia, usually sold in the form of frozen products (FAO, 2007) [5]. Several species of tilapia are cultured commercially, but Nile tilapia (*Oreochromis niloticus*) is the predominant cultured species worldwide. Nile tilapia is a tropical species native to Africa. It is more tolerant to lower temperatures than most of other tilapia species. The lower and upper lethal temperatures for Nile tilapia are 11 - 12 ℃ and 42 ℃, respectively, while the preferred temperature ranges from 31 to 36 ℃ (FAO, 2007) [4].

Global aquaculture production has increased over the past fifty years, from less than 1 million t in the early 50's, to 59.4 million t in 2004. According to FAO (2007) [5] estimates, an additional 40 million t of fish will be required by 2030 just to meet the current levels of consumption.

Fish lipid is regarded as quality lipid being rich in cholesterol and triglyceride. The changes in habitat and nutrition may have a significant impact on the quantity of different components of lipid profile.

Objective of this research is

To study the Impact of aquaculture systems (Earthen and Concrete Pond Systems) on Chemical Composition of Nile tilapia (*Oreochromis niloticus*) in Gezira State.

Materials and Methods

Area of study

In the present investigation, two sampling sites (Earthen and Concrete Pond Fish Farms) were selected at Gezira State.

The similarities and differences in nutritive value of Nile tilapia (*Oreochromis niloticus*) were investigated in aquaculture pond system between earthen and concrete fish ponds via laboratory analysis through this study.

Fish Sampling

A total of 36 samples of Nile tilapia (*Oreochromis niloticus*) were collected from fish farms at Gezira State, 18 representative samples were randomly collected from earthen and concrete pond farms.

Preparation of fish samples

Collected fish were cut into three parts horizontally. Each one was gutted, scaled, fins removed and washed with clean, cold potable water, after that, 30 grams were taken from all three parts and transferred to sterilized container (60 ml size).

Preservation of Samples

All collected samples were put into sterilized containers and preserved immediately in minced ice preservative container by means of layers (first minced ice layer then samples layer and ice layer and so on).

Chemical composition of fish

The samples were minced for proximate analysis (Dry matter (DM%), Crude protein (CP%), lipid% and fibre% as well as ash%) using standard AOAC (Horwitz, 2000) [7] methods. The analyses were done in laboratory of Food Technology, Faculty of Engineering and Technology, University of Gezira.

Statistical analysis

The data was analysed by using statistical package for Social Studies (SPSS version 14.0). Completely Randomized Design (CRD) arrangement was used for means separation between Ponds types. One way analysis of variance (ANOVA) was used for means separation between Pond Types. A P-value of ≤ 0.05 was considered indicative of a statistically significant difference**.**

Results and Discussions

Results

Fish has an important role in food security and poverty alleviation in both rural and urban areas of Sudan, but little is known about the nutritional value of the Nile fish that are normally utilized either fresh or preserved dried, salted or smoked. Better knowledge of their nutritional value, which is expected to be closely associated with fish species, could contribute to the understanding of variability in meat quality of different species of the Nile fish. Moreover, the measurement of some proximate profiles such as protein contents, lipids and moisture contents is often necessary to ensure that they meet the requirements of food regulations and commercial specifications **(**Watermann, 2000) [12].

This study was conducted to evaluate nutritive value of Nile tilapia (*Oreochromis niloticus*) in aquaculture environment, specifically in different types of ponds (earthen and concrete Ponds) in fish farms in Gezira State, mainly crude protein, crude fibre, moisture and dry matter as well as ash.

The findings of the present study showed some fact on the manifesto of the popular cultured fish emphasizing on nutritive value between earthen and concrete ponds of *O. niloticus* which serves as the principle basis in evaluating the nutritional and economical value of the fish.

Nutritional Value

Information concerning the nutritive value of freshwater fishes is useful to ecologists and environmentalists who are interested in determining the effects of changing impacts of biological/environmental conditions on the composition, survival, and population changes within fish species. It is also valuable to nutritionists concerned with readily available sources of low-fat, high-protein foods such as most freshwater fishes, and to the food scientists who are interested in developing them into high-protein foods while ensuring the finest quality flavor, color, odor, texture, and safety obtainable with maximum nutritive value (Kinnesella *et al*., 1978).

The fluctuations in nutritive value parameters in the present

study are shown in table 1 bellow;

Moisture content (MC)

Table (1), showed that, the moisture content (MC) of *O. niloticus* from earthen and concrete ponds was 81.88% and 80.44, respectively. There was a highly significant difference ($P \leq 0.01$) in moisture content of *O. niloticus* between earthen and concrete ponds. The earthen ponds fish was recorded the higher percentage of moisture than concrete ponds.

Dry matter (DM)

Table (1), showed that, the dry matter content of *O. niloticus* from earthen and concrete ponds was 18.12 and 19.56%, respectively. There was a highly significant difference ($P \leq 0.01$) in Dry content of *O. niloticus* between earthen and concrete ponds. The concrete ponds fish was recorded the higher percentage of dry matter than earthen ponds.

These differences probably might be due to the differences in feeding types and ages, although all sampled fish were equal in weight and size but their ages may differ, and the aged fish have more bones than small aged fish, and as bone tissues increase, the dry matter content increase accordingly.

However, the findings of this research are greater than (Fawole *et al*., 2007) [6]. They were investigated proximate composition of body tissues of Nile Tilapia (*Oreochromis niloticus*) and figured-out that; Dry Matter content 7.50%.

Ash Content

Table (1), showed that, the dry matter content of *O. niloticus* from earthen and concrete ponds was 0.20 and 0.27%, respectively. There was a highly significant difference ($P \leq 0.01$) in ash content of *O. niloticus* between earthen and concrete ponds. So, the higher ash content was found in *O. niloticus* from concrete ponds.

These differences probably might be due to the differences in ages, although all sampled fish were equal in weight and size but their ages may differ, and the aged fish hah more bones than less aged fish, and as bone tissues increase ash content increase accordingly. However, the findings are less than (Fawole *et al*., 2007) [6] findings who were investigated proximate composition of body tissues of Nile Tilapia (*Oreochromis niloticus*) and figured-out that; found that, Ash content is 4.55%.

Crude protein (CP)

Table (1), showed that, the crude protein content of *O. niloticus* from earthen and concrete ponds was 17.04 and 17.27%, respectively. There was a highly significant difference ($P \leq 0.01$) in crude protein content of *O. niloticus* between earthen and concrete ponds. So, the higher crude protein content was found in *O. niloticus* from concrete ponds.

These differences probably might be due to the differences in feeding because, fish from earthen pond was fed on natural food (planktons, blue green algae and water plants) and some supplemented food, so the protein may not be as more as in the case of fish from concrete pond which were fed completely on manufactured fish feed which is well balanced protein equilibrium. However, the findings was disagree with Fawole *et al*. (2007) [6] who was figured out that, the CP% of Nile tilapia tissues *O. niloticus* was 38.40% because this study used part of fish consist bone and muscle and as we known bones contain less protein when compared with muscle.

Oil Content

As shown in table (1), the oil percentage level of *O. niloticus* from earthen and concrete ponds was 0.67 and 0.88%, respectively. There was a highly significant difference ($P \leq 0.01$) in oil content of *O. niloticus* between earthen and concrete ponds. So, the higher oil content was found in *O. niloticus* from concrete ponds.

However, the findings are disagreement with Youssouf *et al*. (2013) [13] who was figured out that, the fat% of Nile tilapia *O. niloticus* reared in tanks and in earthen ponds was 8.20%. The differences probably might be due to the differences in feeding grounds because, wild fish is normally eat selectively from the natural feed (planktons and water plants), while concrete ponds cultured fish is depend mainly upon manufactured feed (supplementary diets) and this differ according to ingredients (inputs) used to formulate the feed. As we known one of the fish feed ingredients in Sudan is the cakes which are rich in oil content and this makes the oil in processed feed higher than that of natural feed and fish composition will differ accordingly as it was clearly observed in this study.

Crude fibre Contents

Table (1), showed that, the crude fibre percentage of *O. niloticus* from earthen and concrete ponds was 0.18 and 0.17%, respectively. There was no significant difference ($P > 0.05$) in fibre content of *O. niloticus* between earthen and concrete ponds. So, the higher fibre content was found in *O. niloticus* from earthen ponds.

Conclusion and Recommendations

Conclusion

Fish has an important role in food security and poverty alleviation in both rural and urban areas of Sudan, but little is known about the nutritive value of the Nile fish that are normally utilized either fresh or preserved dried, salted or smoked. The study was conducted to evaluate nutritive value of nile tilapia (*Oreochromis niloticus*) cultured in earthen ponds compared with concrete ponds in fish farms in Gezira State, Sudan. A total of 36 samples of nile tilapia (*Oreochromis niloticus*) were collected from earthen and concrete ponds fish farms around Gezira State and the samples were subjected to chemical analysis (moisture, dry matter, ash, crude protein, fat, and crude fibre). The data was subjected to SPSS by using completely randomized design (CRD). The findings of this study revealed that, *Oreochromis niloticus* from concrete ponds has higher level of nutritive value than earthen ponds farms except fibre contents is higher in earthen ponds farms than concrete ponds farms, and there was highly significant difference ($P \leq 0.01$). In nutritive value of Fish between two types of ponds system, except crude fibre is recorded significant difference at ($P \leq 0.05$) between two ponds culture system.

Recommendations

According to the findings, we recommended that:

- Encouragements and attention should be paid to aquaculture sector in order to shift fish production gradually from fisheries sector to aquaculture systems.
- Measurements of water quality parameters should be taken regularly in order to decide whether to change ponds water or not.

Table 1: Chemical Composition of Nile Tilapia according to Pond Types

	Ponds			
Chemical Composition (%)	**Earthen Ponds**	**Concrete Ponds**	**± S.E**	**Sig.**
Moisture	81.88[a]	80.44[b]	0.050	**
Dry Matter	18.11[b]	19.62[a]	0.030	**
Ash	0.20[b]	0.27[a]	0.008	**
Protein	17.04[b]	17.27[a]	0.031	**
Oil	0.67[b]	0.88[a]	0.007	**
Fibre	0.18[a]	0.17[a]	0.014	NS

[ab] ≡ Means with similar superscripts within the same row are not significant different.
**≡ significant at (P ≤ 0.01).
NS ≡ not significant.
Sig. ≡ Significant Level.
S.E ≡ Standard Error.

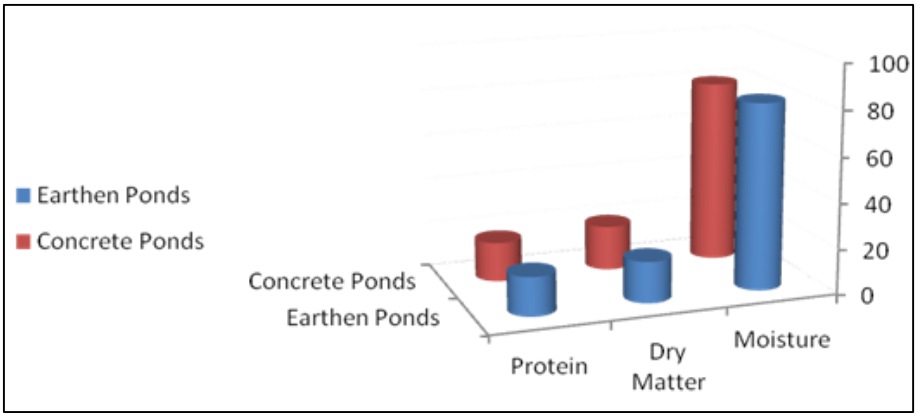

Fig 1: Moisture, Dry Matter and Protein of Nile Tilapia cultured in Different Ponds Systems, Gezira State, Sudan

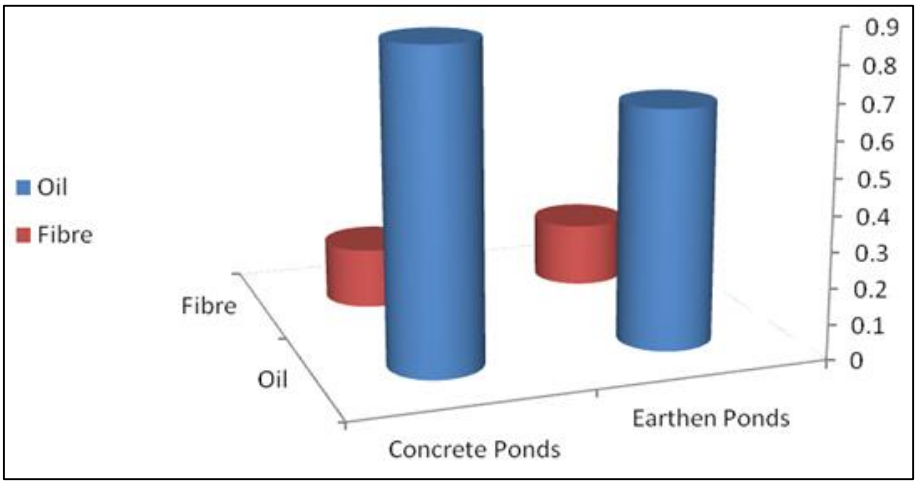

Fig 2: Oil and Fibre of Nile Tilapia Cultured in Different Pond Systems, Gezira State, Sudan

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