FEED AND FEEDING HABITS OF *Oreochromis niloticus* IN HAUREN SHANU BURROW PIT IN KANO CITY, NIGERIA

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ABSTRACT
A study on the Feed and Feeding Habits of Oreochromis niloticus in Hauren shanu Burrow Pit, Kano was carried out where 300 fish specimens were analyzed out of which 134 (44%) had empty stomach while 166 (56%) stomachs had food. Phytoplanktons mostly diatoms and algae accounted for 99% under frequency of occurrence method and 23% by number followed by Zooplanktons with 95.7% by occurrence and 16.6% by number. Other food items were Fish parts (68% by occurrence and 6.85% by number), Insect parts (69.8% by occurrence and 6.89% by number), Detritus (93.3% by occurrence and 17.6% by number) and Unidentified mass (28.9% by number). Diatoms identified include Cyclotella comta, Cocconeis placentula, Synedra ulna, Pinnularia microstauron, Ceratoneis arcus, Stauroneis phoenicenteron while Green algae identified include Chlorella vulgaris, Spirogyra quinina, Zygnema stellinum, Scenedesmus quadricauda, Ostracoda (Cypridopsis). A fish's frequent habitat can be determined by the nature of food composition thus a variation in the seasonal abundance of the favorite food organisms as well as the diurnal abundance may affect the horizontal and vertical movements of the fish stocks. Hence for the production and exploitation of the fish stocks, an adequate knowledge of the relationship between the fishes and food organisms is necessary.

Keywords: Oreochromis niloticus, Food items, Hauren shanu Burrow pit, Kano.

INTRODUCTION

Oreochromis niloticus (Nile tilapia) is a tropical species that shows a preference for life in shallow water. It has a compressed body with cycloid scales. There is absence of a knob – like protuberance on dorsal surface of snout. The upper jaw length shows no sexual dimorphism. The first gill arch has 27 to 33 gill rakers. The lateral line is interrupted. The spinous and soft ray parts of dorsal fin are continuous with the dorsal fin having 16 – 17 spines and 11 – 15 soft rays while the anal fin has 3 spines and 10 – 11 rays. The caudal fin is truncated. During spawning season, the colour of the pectoral, dorsal and caudal fins become reddish. The caudal fin has numerous black bars. (FAO, 2015)

Tilapias are said to be plastic animals because their growth and the maximum size they obtain can be seriously influenced by the physical and biological composition of their environment (Olurin & Aderibigbe, 2006). The lower and upper lethal temperatures for *O. niloticus* are 11 – 12^0C and 42^0C; respectively, while the preferred temperature ranges from 31 to 36^0C.Kamal and Kurt,(2010) reported that *Tilapia* can tolerate a wide range of environmental conditions including factors such as salinity, dissolved oxygen (D.O), temperature, pH and ammonia levels. Therefore, due to the complex nature of the aquatic environment, water quality parameters such as temperature, pH, concentrations of dissolved oxygen (D.O) and ammonia must be monitored.

Researches have shown that *O. niloticus* is an omnivorous grazer that feeds on phytoplanktons, periphyton, aquatic plants, small invertebrates, benthic fauna, detritus and bacterial films associated with detritus. *O. niloticus* also referred to as the *Nile tilapia* can filter feed by entrapping suspended particles including phytoplankton and bacteria on mucous in the buccal cavity, although its main source of nutrition is obtained by surface grazing on periphyton mats. In pond, sexual maturity is reached at an age of 5 – 6 months (Kamal and Kurt, 2010).

Knowledge of the nature of food composition of fish can help to determine the type of habitat that its frequently found. Thus a variation in the seasonal abundance of the favorite food organisms as well as the diurnal abundance may affect the horizontal and vertical movements of the fish stocks. Thus an adequate knowledge of the relationship between the fishes and food organisms is necessary for the production and exploitation of the fish stocks. In the present study, an attempt has been made to understand the feeding habit of *O. niloticus* in Hauren shanu Burrow Pit, Kano.

MATERIALS AND METHODS

Study Area:
The Hauren shanu Pond is located along the Bayero University, Kano Road. It lies between the coordinates of latitude $11^0 58^I 57^{II}$ N and longitude $8^0 30^I 4^{II}$ E.

Sample Collection:
Three Hundred (300) live fish specimens were collected fortnightly between 8:00am to 12:00 noon with the help of Artisanal fishermen using cast nets. These were transported to the laboratory of Biological Sciences, Bayero University, Kano in ice box for further analysis.

Sample Identification:
Identification of the fish specimens was done using standard fish identification guides by Reed *et.al,*(1967) and Olaosebikan and Raji (2004).

Gut Content Analysis

The Numerical method of food analysis was employed in this research and this involves the Frequency of Occurrence (F/O) method and the Number method as described by Hyslop (1980), Smyly (1952) and Windell and Bowen, (1978) The fish specimens were dissected and the stomach contents emptied into a petri dish containing 5% formalin. The stomach contents were later sorted and the relative importance of food items was done using the following standards:

(a) Frequency of Occurrence: The number of stomachs in which a given category of food items occurs was expressed as a percentage of the total number of all non-empty stomachs examined (Windell and Bowen, 1978). Thus the calculation was done on the basis of the following formula as described by Hyslop (1980) and Smyly (1952):

Percentage of occurrence =

$$\frac{\text{No. of guts where food occurred} \times 100}{\text{Total no. of guts analyzed}}$$

(b) Numerical (Number) analysis: The number of food items of a given type that were found in all samples examined was expressed as a percentage of all food items (Windell and Bowen, 1978).

RESULTS

Table 1: Monthly distribution of food items in *O. niloticus* based on F/O method

Food items/Months	Jan	Feb	Mar	Apr	May	June	Total
Phytoplanktons	34	21	21	22	28	39	165
Zooplanktons	31	19	21	22	28	38	159
Insect Parts	28	13	15	14	19	27	116
Fish Parts	27	12	16	16	17	25	113
Detritus	32	17	21	21	28	36	155
Unidentified	34	21	21	22	28	40	166

Table 2: Monthly distribution of food items in *O. niloticus* based on Number method

Food items/Months	Jan	Feb	Mar	Apr	May	June	Total
Phytoplanktons	101	70	87	122	134	161	675
Zooplanktons	83	63	44	89	97	112	488
Insect Parts	28	53	55	25	22	19	202
Fish Parts	31	43	59	27	24	17	201
Detritus	43	80	120	124	85	64	516
Unidentified	74	143	180	123	191	138	849

Table 3: Summary of the stomach contents of *Oreochromis niloticus* in Hauren shanu Burrow Pit, Kano.

	Frequency of Occurrence		Numerical Method	
Food Items	**No**	**%**	**No**	**%**
Fish parts	113	68	201	6.85
Insect parts	116	69.8	202	6.89
Detritus	155	93.3	516	17.6
Phytoplanktons	165	99	675	23
Zooplanktons	159	95.7	488	16.6
Unidentified	166	100	849	28.9

Table 4: Analysis of empty stomach in *Oreochromis niloticus in* Hauren shanu Burrow Pit, Kano.

Months	No. of stomach examined	No. of empty stomach	% of empty stomach
January	50	16	32
February	50	29	58
March	50	29	58
April	50	28	56
May	50	22	44
June	50	10	20

A total of 300 specimens of *O. niloticus* were obtained out of which 134 (44%) had empty stomach while 166 (56%) stomachs were found to contain food items mainly phytoplanktons like diatoms and green algae. Phytoplanktons mostly diatoms and algae accounted for 99% of the content

under frequency of occurrence method and 23% by number followed by zooplanktons with 95.7% by occurrence and 16.6% by number. Other food items were fish parts which accounted for 68% by occurrence and 6.85% by number. Insect parts accounted for 69.8% by occurrence and 6.89% by number. Detritus accounted for 93.3% by occurrence and 17.6% by number. Unidentified mass accounted for 28.9% by number. Diatoms identified include *Cyclotella comta, Cocconeis placentula, Synedra ulna, Pinnularia microstauron, Ceratoneis arcus, Stauroneis phoenicenteron* while Green algae identified include *Chlorella vulgaris, Spirogyra quinina, Zygnema stellinum, Scenedesmus quadricauda, Ostracoda (Cypridopsis).*

The monthly distribution of food items in the stomach of *O. niloticus* in Haurenshanu Burrow Pit, Kano are presented in Table 1, 2and 3 while the monthly analysis of empty stomach in *O. niloticus* are presented in table 4.

DISCUSSION

Investigation on the food and feeding habits of Cichlids by numerical and frequency of occurrence methods have been carried out by various researchers and these include the works of Komolafe and Arawomo (1998), Agbabiaka (2010), Oso *et al.*, (2006), Omondi *et al.*(2013) and Flipos *et al.*(2013).In order to analyze the contents of the stomach of *O. niloticus* in Haurenshanu Burrow Pit, Kano, two methods of analysis were employed i.e. Frequency of Occurrence which provides information on the various types of food organisms the fish fed upon and the Numerical (number) method which shows the dietary items occurring in the largest number (Agbabiaka, 2010).

Out of the 300 specimens examined, 134 (44%) had empty stomach. The percentage of empty stomach was high in February, March and April for *O. niloticus* (58%, 58% and 56% respectively) and this could be due to the fact that in Nigeria the rain usually comes around the month of May and the downpour increases across the months down to October as two seasons are recognized in Nigeria (Rainy and Dry).Thus the high percentage of empty stomachs in these months could be attributed to the fact that the dry season was at its peak thus the availability of food items in water bodies tend to decline prior to the onset of rains as primary productivity tends to be low during this period. The percentage of empty stomach dropped from 56% to 44% in the month of May and this might be as a result of the commencement of the rains making available dietary food items. Evidence can be seen in table 2 where there is a high availability of phytoplanktons and zooplanktons in *O. niloticus* in the month of May (134 and 97 respectively). Furthermore, the occurrence of fish parts and insect parts in the stomachs were high in the month of March (55 and 59 respectively) and this could be attributed to the low productivity of the pond during this period due to extreme dryness thus the fishes tend to feed more on other fishes and insects available in the pond.

Therefore, the gut content analysis of *O. niloticus* showed that the fish feed on a variety of food items. Phytoplanktons mostly diatoms and algae accounted for 99% of the content under frequency of occurrence method and 23% by number followed by zooplanktons with 95.7% by occurrence and 16.6% by number. Other food items were fish parts which accounted for 68% by occurrence and 6.85% by number. Insect parts accounted for 69.8% by occurrence and 6.89% by number. Detritus accounted for 93.3% by occurrence and 17.6% by number. Unidentified mass accounted for 28.9% by number. Main dietary organisms identified from stomach analyzed include Diatoms (*Cyclotella comta, Cocconeis placentula, Synedra ulna, Pinnularia microstauron, Ceratoneis arcus, Stauroneis phoenicenteron*), Green algae (*Chlorella vulgaris, Spirogyra quinina, Zygnema stellinum, Scenedesmus quadricauda*), Ostracoda (*Cypridopsis*) and others which include unidentified items. These are shown in Appendix I.

Kamal and Kurt (2010) reported that tilapias are omnivorous in their feeding habit. Adult Tilapia are principally herbivorous but readily adapt to complete commercial diets based on plant and animal proteins sources. Adult *Oreochromis niloticus* was reported to feed on a variety of food items including phytoplankton, macrophytes, planktonic and benthic aquatic invertebrates, insects and detritus (Yirgaw *et al.*, 2000; Oso *et al.*, 2006; Alemayehu and Prabu, 2008) whereas juveniles are generally omnivorous feeding on zooplankton, insect larvae (Todurancea *et al.*, 1988) and phytoplanktons of which diatoms was the major dietary component (Witte and Winter, 1995).

In the study of Komolafe and Arawomo (1998), the food items present in the stomach of *Oreochromis niloticus* were green algae (1.07%), diatoms (3.08%), detritus (25.64%), higher plant fragments(18.61%) and insect remains (7.73%).Oso *et al.*(2006) determined the following food items in the stomachs of *O. niloticus* in his study under Frequency of Occurrence method; green algae (46%), detritus (44.82%), filamentous algae (spirogyra) (42.36%) and insect parts (19.21%).In the study of Oso *et al.*(2006), the food items determined in the stomach of *Oreochromis niloticus* include higher plants remains, macrophytes which accounted for 49.29% of the content under frequency of occurrence method followed by green algae (chlamydomonas) with 46.00%. Detritus and filamentous algae (spirogyra) had 44.82 and 42.36% respectively. Insect parts recorded 19.21% which is the least of the food items found. Out of the 299

specimens of *Oreochromis niloticus* examined in his study, 96 (32.11%) had empty stomach.

Omondi *et al.*(2013) reported that the food items in the stomach of *O. niloticus* in his study consisted mainly of algae, detritus and zooplanktons. Others were higher plant materials, fish and insects. Algae were reported to be predominantly consumed by *O. niloticus* in high proportions ranging between 26.5 and 88.1% of the diet. Omondi *et al.*(2013) reported that the food items in the stomachs of *Oreochromis niloticus* in his study consisted mainly of algae, detritus, and zooplankton. Other stomach components were higher plant materials, fish and insects. Algae were predominantly consumed by *Oreochromis niloticus* of all size classes in high proportions ranging between 26.5 and 88.1% of the diet. While the importance of zooplanktons as food for *Oreochromis niloticus* decreased with size of fish, the reverse trend occurred for detritus with the proportion ingested increasing with the size of *Oreochromis niloticus*. Among the zooplankton species forming the main diet of *Oreochromis niloticus* are the cladocerans and some rotifers.

Flipos *et al.*(2013) reported that the major food items found in the stomach contents of *O. niloticus* in his study were phytoplanktons, macrophytes and detritus. Others were zooplanktons, insects, and ostracods. He reported that using the Frequency of occurrence method, phytoplanktons accounted for 80.1% followed by detritus (75.2%), diatoms (52.0%), insects (19.9%), green algae (59.6%), ostracods (17.0%) e.t.c. Bagenal (1978) reported that fish stomach content per se may not reflect consumers food because some food items are digested rapidly.

CONCLUSION

The result obtained shows that *O. niloticus* is omnivorous in its feeding habit, although fish parts accounted for 6.85% by number and 68% by occurrence and this recorded the least of all food items identified. About 134(44%) stomachs of *O. niloticus* examined had empty stomach and this could be due to the fact that the fishes were caught during the dry season and towards the onset of rainy season. It could also be due to the fact that the food items in their stomach may have been regurgitated or digested as the fish struggled for escape in the nets.

REFERENCES

Agbabiaka, L. A. (2010): Food and Feeding Habits of *Tilapia zilli* (Pisces: Cichlidae) in River Otamiri South – Eastern Nigeria.*Bioscience Discovery*,**3 (2):** 146 – 148http://www.biosciencediscovery.com ISSN:2231 – 024X (Online).

Alemayehu, N. and Prabu, P.C.(2008): Abundance, Food Habits and Breeding Season of Exotic *Tilapia zilli* and Native *Oreochromis niloticus* L. Fish Species in Lake Ziway, Ethiopia. Maejo*Int. J. Sci. Tech*., **2 (2):** 345–360

Bagenal, T. B. (1978): *Methods for assessment of fish production in freshwaters*. Blackwell Scientific Publications, Oxford. 365pp.

FAO (2015): Cultured Aquatic Species Information Programme. Fisheries and Aquaculture Department.*Bulletin.*(www.fao.org/fishery/culturedspecies/oreochromis_niloticus/en) Retrieved on 22/07/2015

Hyslop, E. J (1980): Stomach content analysis. A review of methods and their application.*J. Fish Biol*,**17**: 411–429.

Kamal, M. and Kurt, A. (2010): *Tilapia*: Environmental biology and nutritional requirements. South Dakota Cooperative Extension Service USDA Doc. Retrieved from http://pubstorage.sdstate.edu/AgBio-Publications/articles/FS963_02.pdf 12/11/2014

Komolafe, O. O. and Arawomo, G. A. O. (1998): The distribution and feeding habits of a cichlid fish, *Oreochromis niloticus*(Linnaeus) in Opa Reservoiur, Ile – Ife.

Olaosebikan, B.D. and Raji, A. (2004).Field Guide of Nigerian Freshwater Fishes. Second edition, Ilorin, Nigeria. Remi Thomas Printing Press. 115pp.

Olurin, K. B. and Aderigba, O. A. (2006): Length – weight relationship and condition factor of pond reared juvenile *Oreochromis niloticus*. *Journal of Zoology.***1(2):** 82–85

Omondi, R., Yasindi, A. W. and Magana, A. M. (2013): Food and feeding habits of three main fish species in Lake Baringo, Kenya. *Journal of Ecology and the Natural Environment*. Vol. **5 (9)**, pp. 224–230.

Oso, J. A., Ayodele, I. A. and O. Fagbuaro (2006): Food and feeding habits of *Oreochromis niloticus*(L.) and *Sarotherodon galilaeus*(L.) in a Tropical Reservoir. *World Journal of Zoology***1(2):** 118–121, 2006.

Reed, W.T., Burchard, A.J., Hopson, J., Jenness, J. and Yaro, I. (1967).Fish and fisheries of Northern Nigeria, Gaskia Corporation Zaria, Ministry of Agriculture, Northern Nigeria, 226pp.

Smyly, W. J. P., (1952): Observation of food of fry of perch (*perca fluviatilis* Linn.) in windermere. *Proceedings of the Zoological Society*,**122:** 407–416.

Todurancea, C., Fernando, C.H and Paggi, J.C. (1988): Food and feeding ecology of *Oreochromis niloticus*(Linnaeaus, 1758) juveniles in Lake Awassa, Ethiopia. *Hydrobiologia*, **79:** 267 – 289

Windell, J. T. and Bowen, B. H. (1978): Methods for a study of fish diet based on analysis of stomach contents. In: *Methods for the Assessment of Fish Production in Freshwaters*, 3rd ed. (Bagenal, T. B. ed.) Blackwell Scientific Publications, London. Pp. 219 – 226.

Witte, F. and Winter, W. (1995): Biology of the major fish species of Lake Victoria. In: *Fish stocks and fisheries of Lake Victoria. A Handbook for Field Observations.* Samara Publishing Cardigan, pp: 301–320

Yirgaw, T., Demeke, A. and Seyoum, M. (2000): The food and feeding habit of *Oreochromis niloticus* L., (Pisces: Cichlidae) in Lake Chamo, Ethiopia. Sinet: *Ethiop.J.Sci.,***23 (1):** 1–12

APPENDIX I

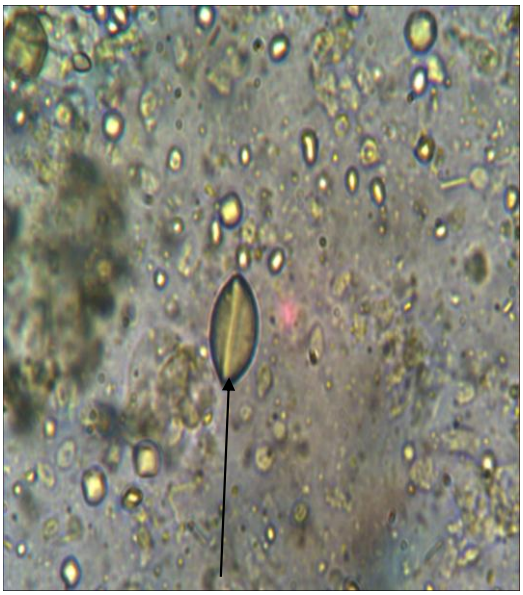

Plate I: Diatom, *Cocconeis placentula*(plankton)

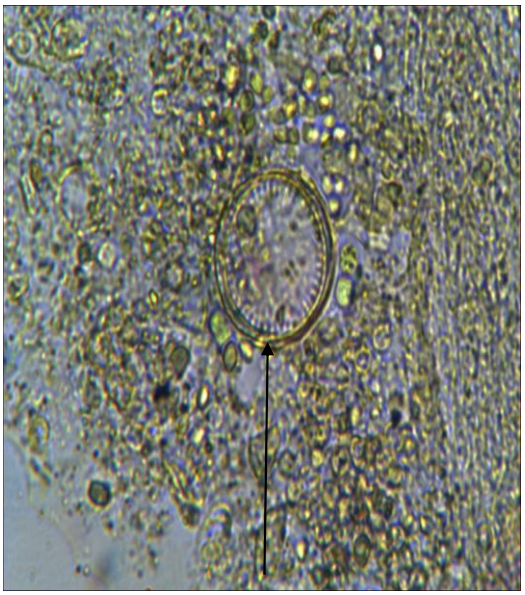

Plate II: Diatom, *Cyclotella comta*(plankton)

Plate III: Diatom, *Synedra ulna* (plankton)

Plate IV: Diatom, *Pinnularia microstauron* (benthic species)

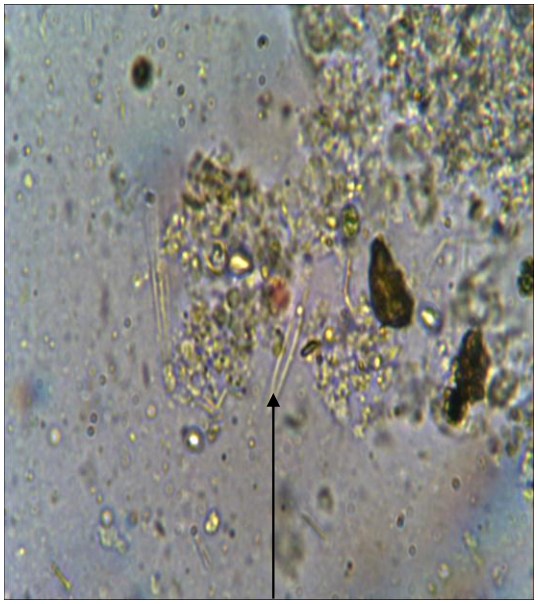

Plate V: Diatom, *Ceratoneis arcus* (benthic species)

Plate VI: Diatom, *Stauroneis phoenicenteron*

Plate VII: Green algae (Chlorophyceae), *Zygnema stellinum*

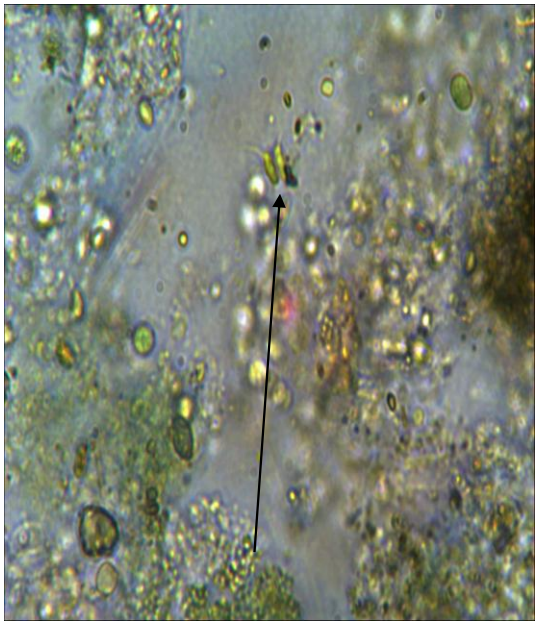

Plate VIII: Green algae (Chlorophyceae), *Scenedesmus quadricauda*

Plate IX: Green algae (Chlorophyceae), *Spirogyra quinina*

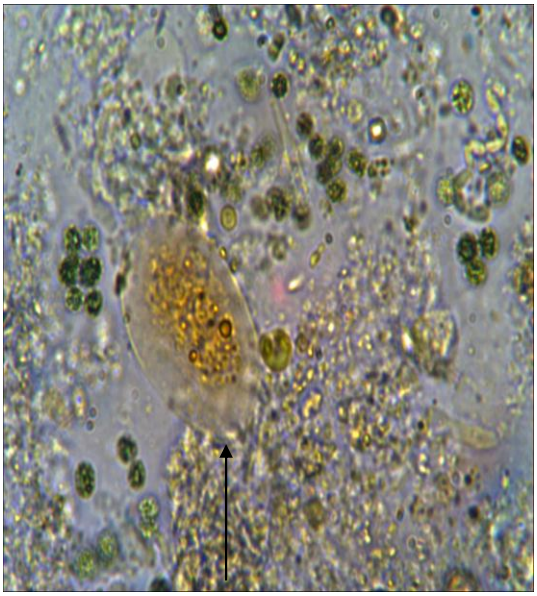

Plate X: Green algae (Chlorophyceae), *Chlorella vulgaris*

Plate XI: Ostracoda*(Cypridopsis)*

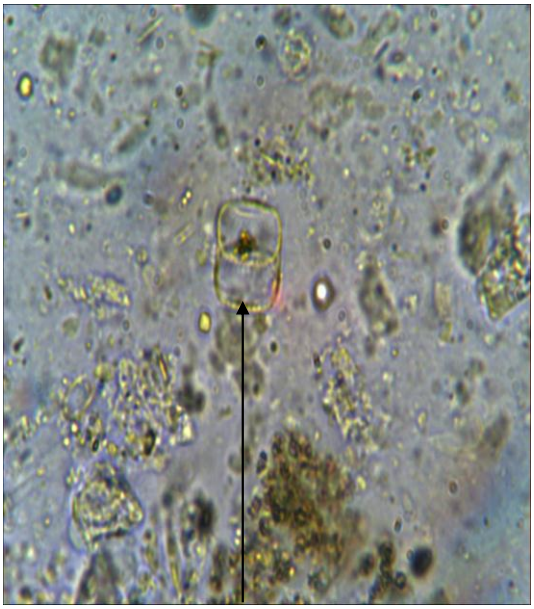

Plate XII: An unidentified food item