



Full Length Research Paper

Proximate composition and amino acid profiles of snakehead (*Parachanna obscura*) mudfish (*Clarias gariepinus*) and African pike (*Hepsetus odoe*) in Igboho dam, South–West Nigeria

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This study was conducted to determine the proximate composition and amino acid profile of some selected commercially important fish species in Igboho Dam, South West Nigeria. Three fish species; snakehead (*Parachanna obscura*), mudfish (*Clarias gariepinus*) and African pike (*Hepsetus odoe*) were purchased from the landings of local fisherman and analysed for their proximate composition and amino acid profile. The data analysis of the proximate composition revealed that *Parachanna obscura* has the highest crude protein content (20.77 ± 0.08) and the highest crude fat (1.81 ± 0.02). However, the highest moisture was recorded in *Clarias gariepinus* (76.85 ± 0.01). The order of crude protein in the three fish species studied was; *Parachanna obscura* > *Hepsetus odoe* > *Clarias gariepinus*. The amino acid profile also revealed that fish species contain all the essential amino acid needed for growth. The highest amount of essential amino acid was recorded in *Hepsetus odoe* (9.90 ± 0.24). There is no significant difference among the fish species in respect of the proximate composition and the amino acid profile. The study clearly indicated that proximate composition values obtained would be useful in helping consumers in choosing fish based on their nutritional values and will also provide an update to food composition database.

Key words: Proximate composition, Amino Acid Profile, *Parachanna obscura*, *Clarias gariepinus*, *Hepsetus odoe*.

INTRODUCTION

Fish is an important foodstuff especially in developing countries due to its high protein content and nutritional value of unsaturated fatty acid (Effiong and Fakunle, 2011). It is also widely acceptable because of its high palatability, low cholesterol and tender flesh (Eyo, 2001). It is sole accessible or affordable source of animal protein for the poor households in urban or semi – urban areas (Bene and Heck, 2005). Fish is generally appreciated as

one of the healthiest and cheapest source of protein and it has essential amino acids (Lysine, methionine, cysteine, threonine and tryptophan), micro – and macro – elements (calcium, phosphorus, fluorine, iodine), fats that are valuable sources of energy, fat – soluble vitamins and unsaturated fatty acids that amongst other benefit have a hypocholesterotemic effect (antiarteriosclerosis (Fernandez and Venkatramann, 1993; Ismail 2005).

Proteins, especially the amino acids are required for foetal development and growth. Dietary protein, the amino acids are needed principally for growth, metabolism and maintenance especially in young ones. (Adefemi, 2011). An important indicator of protein quality is the indispensable essential amino acid (Chukwuemeka, 2008). Moreover, fish meat contains significantly low lipids and higher water than beef or chicken and is favoured over other white or red meats (Nestle, 2000). Furthermore, the cholesterol level in fish is low when compared with meat (Harris, 1997) and thus often recommended for consumption especially among the adult population. Hitherto, protein and fat are the major nutrient in fish and their level help to define the nutritional status of a particular organism (Aberoumad and Pourshafi, 2010).

The current status of fish production in Nigeria can only be said to pose a serious developmental challenges. The demand for fish in Nigeria mostly outstrips the local production. Nigeria is the largest fish consumer in Africa with over 1.5 million metric tons of fish consumed annually. Yet, Nigeria imports over 900,000 metric tons of fish while its domestic catch is estimated at 450,000 metric tons/year (Ozigbo, 2013). The high demand for fish products call for studies on the nutritional status of different fish species for its maximum utilization. Moreover, the determination of some proximate profile such as protein content, lipid, ash and other nutrients is often necessary to ensure that they were within the range of dietary requirement and commercial specification (Watermann, 2000; Tawfik, 2009 ; Surthanshiny and Sivashantini, 2011a). However, the nutritional composition of fish varies greatly from one species to another depending on age, source, feeding habit, size, sex and sexual variations due to spanning, environment and season (Silva and Chamul,2000;Effiong and Mohammed, 2008).

Snakehead (*Parachanna obscura* Gunther,1861), mudfish (*Clarias gariepinus* Burchell,1822) and African Pike (*Hepsetus odoe* Blotch, 1794) belonging to the families Channidae, Clarridae and Hepsetidae respectively are among the species of freshwater fishes that are commonly utilized in fish culture especially in developing countries where they are cultivated for food. Since their biology have been investigated including food habits and their potentials as cultivated food fish; this paper therefore investigated the proximate composition and amino acid profiles of these three fish species from Igboho Dam which are the most preferred species by the local populace in order to assess their nutritional composition.

MATERIALS AND METHOD

Study Area

The study site is Igboho Dam, located in Igboho, Oyo State, South–West Nigeria. The dam is situated on

Longitude, 3^o45E and Latitude 8^o50N. The dam lies at the South – Eastern part of Igboho town with an altitude of 445 meters below sea level. The catchment area is about 54.8 hectares with a maximum depth of 10 meters. The size of the impoundment area is about 30 hectares and the water capacity is about 1,200,000m³. The dam is well supplied with water from three main rivers that flows into it throughout the seasons. The dam was constructed for provision of water for the people in Igboho town and its environment but licensed fisherman are allowed to fish from the dam.

Sample Acquisition

Fish samples of *Parachanna obscura* (Gunther, 1861), *Clarias gariepinus* (Burchell, 1822) and *Hepsetus odoe* (Blotch, 1794) were purchased from the landings of fishermen at the dam with each species collected separately and labeled accordingly. The samples were placed in polythene bags and were immediately transported in icebox for the laboratory where they were washed with running water to remove dirt before analysis. The fish samples were then weighed and standard length also measured before being stored inside deep freezer at about – 10^oC prior to analysis as adopted from Buikema *et al.*, (1982).

Fish Samples Preparation and Digestion.

The fresh fish samples were placed on an already sterilized chopping board and incised vertically to exposes the inner portion of the fish. It was then sliced into pieces with a sterilized knife and was separately dried in a laboratory ceramic mortar and pestle and sieved with 2mm sieve. The powdered samples were digested using the procedure described by (AOAC, 1990).

Proximate Analysis

The proximate components were analysed using AOAC (1990). Fish samples were analysed for the following;

Moisture content: The fish moisture content was determined by drying the sample in a hot air at 105^oC until constant weight was obtained. The percentage difference due to loss of water was then calculated.

Protein content: It was determined by Kjeldah method which involves digestion of organic nitrogen of 1g of grand fish sample using concentrated tetraoxosulphate (VI) acid which converts it to ammonium tetraoxosulphate VI. It was then diluted and made alkaline with sodium hydroxide, followed by distillation. The liberated ammonia was collected in a boric acid solution and determined via titration. The percentage concentration of protein in the sample was then calculated.

Ash content: It was determined using drying ashing procedure by burning of 1g of homogenized dried sample

in a muffle furnace at 550 to 600°C until the residue become completely white. The percent of ash was calculated as; percentage (%) of ash = (Weight of ash/Weight of Sample) X 100.

Fat content: This was estimated using 1.0g of completely dried fish sample, placed in the Soxhlet extractor and extracted with a non-polar solvent, ethyl ether. After extraction, the solvent was evaporated and the extracted materials were weighted. The percentage of fat content was calculated as follows:

Percentage (%) of fat = (Weight of extract/Weight of sample) X 100

Fibre content: A1.0g of dried sample was digested with 0.128M H₂SO₄ with two drops of octanol to prevent foaming. The content was boiled for 30min, and the filtered and washed to remove acid. This residue was boiled with 0.223M. KOH for 30min, and then washed in boiling water and acetone. The residue was dried and ignited in muffle furnace. The loss of weight represents the crude fibre.

Carbohydrate content: This was determined by percentage differences of other contents.

Amino Acids Analysis

The amino acid profile in a known sample was determined using methods described by Sparkman *et al.*, (1958). The known sample was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator and then located into the technician Sequential Multisampling Amino Acid Analyser (TSM) Model DNA 0209. The TSM analyser is designed to separate and analyse free acidic, neutral and basic amino acids of the hydrolyzed. The period of an analysis lasted for 76 minutes.

Statistical Analysis

The descriptive statistics (mean and standard deviation) were conducted while statistical significance of differences (P < 0.05) were determined by analysis of variance (ANOVA) with SPSS version 10.0 (Ducan, 1955).

RESULTS AND DISCUSSION

The proximate composition of the three fish species analyzed is shown in [Table 1](#). The fish species investigated in this present study showed variations in nutrient composition. The moisture content values obtained for the fishes ranged from 74.03 – 76.85%. The least moisture content value was obtained in *Parachanna obscura* while the highest in *Hepsetus odoe*. The crude protein values obtained for the fishes show that *Parachanna obscura* had the highest amount of crude

protein. The protein value range was between 18.88 – 20.77%. The value of fat content in the three fish species were in the order of *P. obscura* > *C. gariepinus* > *H. odoe*. The carbohydrate content of range from 2.15 – 2.95% with the highest value obtained in *H. odoe* and the least in *P. obscura*

The ash content was within the range of 0.93 – 1.25% with the lowest value obtained in *C. gariepinus*. However the mean crude ash content in the three fish species was 1.07% (% wet weight).

Fish is composed of mainly water, lipid, ash and protein though small amounts of carbohydrate and non –protein compounds are present in a small amount. (Azim *et al.*, 2012) Most fishes usually consist of water (70-80%), protein (20-30%) and 2-12% of lipid (Ali *et al.*, 2005). The three fish species examined are high in protein content *Parachanna obscura* (20.27%), *Clarias gariepinus* (18.88%) and *Hepsetus odoe* (19.27%). The protein content of *Parachanna obscura* compares favourably with that of other members of the family Channidae (Ama-Abasi and Ogar, 2013; *Channa obscura* (Adeyeye and Ayoola, 2010) *Channa striatus* (Zuraini *et al.*, 2006) and Snakehead murrel (Narhasan, 2008). The high crude protein content of *Parachanna obscura* recorded in this study make it a highly valued food fish and thus its aquaculture should be extensively explored in order to increase the protein intake of the populace in the face of the rising cost of other sources of protein like meat and chicken. The crude protein content of these fish species is higher than that of the egg yolk reported by (CFCD) 2002 to be 15%.

Higher value of crude protein was reported in *Clarias gariepinus* (44.28%) by Mohammed *et al.*, (2011) which is Similar to the value reported by Effiong and Fakunle (2012) who reported a relatively higher percentage crude protein in *Clarias gariepinus* (36.56 ± 0.22) from Lake Kainji, Nigeria and Onyia *et al.*, (2010) who also reported a crude protein value of 38.57% for the same fish species. However Olayemi (2011) reported a crude protein value of 7.24% to 16.24% for the same *Clarias gariepinus* and Olakunle (2012) reported a value of 14.60% for a similar catfish. Also, Adeosun *et al.*, (2014) obtained a crude protein value of 17.10% for Wild *Clarias gariepinus*. These observed differences in value could be due to absorption capability and conversion potentials of essential nutrients from their diets or their local environment.

Fawole *et al.*, (2013) reported a protein content value of 26.18% for *Hepsetus odoe* which is much higher than the value obtained in this study (19.27%). This is because the nutritional components of the freshwater fishes differ greatly between species, sexes, seasons and geographical localities. (Zenebe *et al.*, 1996). However, the protein content of the three fish species is higher than those reported in beef (18%), lamp (16%), pork (10%), haddock (17%), mackerel (17%) and oyster (11%). (Brain and Allan, 1997;

Table 1: Proximate Composition of Experimental Fish Samples (% wet weight)

Species	Crude Protein (% w/w)	Crude fat (%w/w)	Ash (%w/w)	Moisture (% w/w)	Carbohydrate (% w/w)
<i>Parachanna obscura</i>	20.77 ± 0.08	1.81 ± 0.02	1.25 ± 0.03	74.03 ± 0.01	2.15 ± 0.06
<i>Clarias gariepinus</i>	18.88 ± 0.08	0.83 ± 0.02	0.93 ± 0.01	76.85 ± 0.01	2.50 ± 0.05
<i>Hepsetus odoe</i>	19.27 ± 0.10	0.75 ± 0.02	1.04 ± 0.01	75.99 ± 0.03	2.95 ± 0.07

Values are mean ± S D of three separate determinations

Bhuiyan *et al.*, 1986; Abdullahi and Abolude, 2002).

Fish can be grouped into four categories according to their fat content as lean fish (< 2%), low (2 – 4%), medium (4 – 8%) and high fat (>8%) (Ackman, 1989). It was reported by Osman *et al.*, (2001) and Osibona *et al.*, (2009) that low fat fish have higher water content as observed in this study. In terms of lipid content, the three fish species examined can be considered in the lean fish category. The values obtained are *Clarias gariepinus* (0.83%); *Parachanna obscura* (1.81%) and *Hepsetus odoe* (0.75%). This result obtained is consistent with the result for lipid content of three species of Scomberoides fish from Sri-Lankan waters reported by Sutharshiny and Sivashanthini, 2011) and a similar work carried out by Olakunle (2012) on a cat fish with a fat value of 1.38%. However, fat content varies with species, age, size and also season (Oluwaniyi and Dosunmu, 2009)

Body composition is a good indicator for the physiological condition of fish. The percentage of water is a good indicator of its relative content of energy, proteins and lipids. (Olagunju *et al.*, 2012). The lower the percentage of water, the greater the lipid and protein contents and the higher the energy density of the fish. (Dempson *et al.*, 2004; Ali *et al.*, 2005). This pattern was also observed in this study. High moisture content was recorded in the three fish species. However, high moisture content in fish is conducive for human organs which it helps to lubricate (Kris – Etherton *et al.*, 2003). Similar results of high moisture content of the fish samples was also observed by Abolude and Abdullai (2003), Otitologbon *et al.*, (1997), Aberoumad and Pourshafi (2010); Ravichandran *et al.*, (2011) and Olakunle (2012).The moisture content of the fishes was within the acceptable level (60-80%) in all the samples. This could be attributed to stable water levels in the environmental location where the fish samples were collected. (Olagunju *et al.*, 2012). However, the high moisture content of the fish samples would increase the level of deterioration of fish when kept for a long time (Adefemi, 2011). The high moisture content increases the susceptibility to microbial spoilage, oxidative degradation of Polysaturated fatty acids and consequently decrease in quality of the fishes for longer preservation. A good source of energy that comes to mind is carbohydrate which helps in body development and growth. However, the carbohydrate content in fish is generally low and practically considered to be zero (Payne *et al.*, 1999). The

value recorded in this study is also low; *P.obscura* (2.15%), *C.gariepinus* (2.50%), *H.odoe* for (2.95%) which may be as a result of high values of moisture and a relatively high value of crude protein content. Low value of carbohydrate (1.85%) was also reported by Olakunle (2012)

The observed result of the ash content is as follows; *P. obscura* (1.25%) *C.gariepinus* (0.93%), *H.odoe* (1.04%). Since ash is the measure of the mineral content of a food item, this results indicates that the fish species are good sources of minerals such as calcium, potassium, zinc, iron and magnesium.

The amino acid composition obtained for the three fishes is shown on Table 2. Twenty –two different amino acids were obtained. All the essential amino acids with Histidine that are very important for the human body are present in the fish species examined.

The total amino acid in *Clarias gariepinus* was 18.55 ± 0.35, *Parachanna obscura*, 18.34 ± 0.33 and *Hepsetus odoe* 21.11 ± 0.46. The total essential amino acids are as follows; *Clarias gariepinus* 8.97 ± 0.16; *Parachanna obscura* 8.86 ± 0.16 and *Hepsetus odoe* was 9.90 ± 0.24. (Table 2). The highest total essential amino acids was in *Hepsetus odoe*. The total value for non- essential amino acid is as follows; *Clarias gariepinus* 9.36 ± 0.17; *Parachanna obscura* 9.69 ± 0.19 and *Hepsetus odoe* 11.21 ± 0.21.

The results of the amino acid analysis of the fish species revealed that the same type amino acids were present. This may be as a result of the fact that only the tissues were analysed thus confirm the report made by Sadiku and Oladimeji (1989) that concentrations of the amino acids depends on the nature of the tissue analyzed. The amount of amino acid varies in the three fish species, however, the concentration of the amino acid were not significantly different between these fish species, thus eating any of these fish species would provide virtually type of amino acids in the diet.

Mai *et al.*, (1980) compared the amino acid composition of six freshwater species white sucker (*Catostomus commersoni*) burbot (*Lotalota*), black crappie (*Pomoxis nigromaculatus*) rainbow trout (*Ornykiss*), walleye pike

Table 2: Amino acid profile (g/100g amino acid) in snakehead (*Parachanna obscura*) mud fish (*Clarias gariepinus*) and African Pike (*Hepsetus odoe*)

Amino acids	P. obscura	C. gariepinus	H. odoe
Glutamic acid	2.92 ± 0.02	3.00 ± 0.02	3.65 ± 0.02
Aspartic acid	1.81 ± 0.02	1.82 ± 0.03	1.92 ± 0.02
*Lysine	1.76 ± 0.01	1.67 ± 0.01	1.73 ± 0.01
*Leucine	1.51 ± 0.02	1.51 ± 0.02	1.58 ± 0.03
Arginine	1.11 ± 0.02	1.07 ± 0.02	1.18 ± 0.02
Alanine	1.04 ± 0.01	1.11 ± 0.02	1.25 ± 0.02
*Valine	0.88 ± 0.01	0.85 ± 0.01	0.98 ± 0.04
*Isoleucine	0.84 ± 0.01	0.81 ± 0.02	0.91 ± 0.02
Glycine	0.82 ± 0.01	0.83 ± 0.02	0.83 ± 0.02
*Threonine	0.78 ± 0.01	0.76 ± 0.01	0.81 ± 0.02
Serine	0.72 ± 0.02	0.76 ± 0.01	0.91 ± 0.02
*Phenylalanine	0.69 ± 0.02	0.67 ± 0.02	0.75 ± 0.02
Proline	0.61 ± 0.02	0.63 ± 0.01	0.71 ± 0.02
*Methionine	0.53 ± 0.01	0.51 ± 0.01	0.59 ± 0.02
a. Histidine	0.42 ± 0.02	0.41 ± 0.02	0.52 ± 0.02
*Cysteine	0.18 ± 0.01	0.19 ± 0.01	0.30 ± 0.02
*Tyrosine	0.21 ± 0.01	0.24 ± 0.01	0.32 ± 0.02
*Ornithine	0.11 ± 0.02	0.04 ± 0.01	0.08 ± 0.01
Taurine	0.09 ± 0.02	0.25 ± 0.01	0.39 ± 0.02
Aminobutyric	0.07 ± 0.01	0.11 ± 0.02	0.19 ± 0.02
Hydroxyproline	0.06 ± 0.01	0.07 ± 0.01	0.13 ± 0.02
*Tryptophan	1.17 ± 0.01	1.23 ± 0.02	1.40 ± 0.02
Total	18.34 ± 0.33	18.55 ± 0.35	21.11 ± 0.46
TEAA	8.97 ± 0.16	8.86 ± 0.16	9.90 ± 0.24
TNEAA	9.36 ± 0.17	9.69 ± 0.19	11.21 ± 0.21

* Essential amino acids according to FAO/WHO/UNU 1985

a. Histidine- Indispensable amino acid

TEAA: Total Essential Amino Acids.

TNEAA: Total Non Essential Amino Acids

Table 3: Essential and Non-essential amino acids (g/100g amino acid) in snakehead (*Parachanna obscura*), mudfish (*Clarias gariepinus*) and African Pike (*Hepsetus odoe*)

Amino acids	P. obscura	C. gariepinus	H. odoe
ΣEAA	8.97	8.86	9.90
ΣNEAA	9.36	9.69	11.21
ΣEAA/ΣNEAA	0.96	0.91	0.88

(*Stizostedion vitreum*) and yellow perch (*Perca flavescens*) and found a slight difference among these freshwater fish species. Wesslinova (2000) stated that data on amino acid type and their concentrations depend on the season, geographical location and growth conditions.

In this study, glutamic acid was the most predominant among all the amino acids in the three fish species. It was 3.65 ± 0.02 for *H. odoe* with no significance difference between *C. gariepinus* and *P. obscura* at $P > 0.05$. The dominance of glutamic acid as a major amino acid reported in this study is similar to previous reports on amino acid composition of coho salmon (Arai, 1981); Cherry Salmon (Ogata *et al.*, 1983); Channel Catfish (Wilson and Poe, 1985); *Clupea harengus*, *Scomber scombrus*, *Trachurus trachurus* and *Urophycis tenuis* (Oluwaniyi and Dosumu, 2009).

Furthermore, Osibona (2011) reported higher amount of glutamic acid in *Clarias gariepinus*, *Tilapia zilli*, *Pentaneumus quinquarius* and *Pseudolithus typus*. Abdullai and Balogun (2006) also reported eighteen amino acids and glutamic acid being the highest concentration followed by lysine in *O niloticus*, *T. zilli*, *S. galileaus*, *H. fasciatus*, *C. gariepinus* and *C. anguillar*.

Other studies on qualitative and quantitative properties of amino acid composition in several species include Limin *et al.*, 2006; Chukuemeka, 2008; Ovisspour *et al.*, (2009). In critical illnesses, muscles glutamine serves as an important carrier of ammonia (nitrogen) to the immune system (Deutz *et al.*, 1982). Glutamic acid is also essential for cell proliferation. (hao *et al.*, 2010).

This study further revealed that the three fish species had all the essential amino acids. These essential amino acids cannot be manufactured in human bodies but can only be obtained from food. This is an indication that these fish species would be a good source of essential amino acids in the diet of the populace. To obtain maximal growth in human body, the dietary essential Amino Acid should be available at levels equal to or higher than essential Amino Acid levels in fish. (Chukuemeka, 2008). Steffens (1989) stated that a close correlation exists between the pattern of essential amino acids found in the body tissue of an animal and the dietary requirement pattern.

The content of essential amino acids in *H. odoe* (9.90 ± 0.24) was higher than the value in *P. obscura* (8.97 ± 0.16) and *C. gariepinus* (8.86 ± 0.1) respectively. However, the content of non-essential amino acid was highest in *H. odoe* than in *C. gariepinus* and *P. obscura*. (Table 2) This result obtained correspond with that of Dezhabad *et al.*, 2012) which reported high value of essential amino acid content and high non-essential amino acid content in the same fish species examined.

Deficiency of essential amino acids may hinder healing recovery processes. For example, glycine, a major component of human skin collagen together with other amino acids (e.g. alanine, proline, arginine, serine, isoleucine and phenylalanine form polypeptides for growth and tissue healing (Witte *et al.*, 2002). Leucine promotes the healing of bones, skin and muscles tissue. Isoleucine is necessary for hemoglobin formation, stabilizing and regulating blood sugar and energy. Witono *et al.*, (2014) affirmed that failure to obtain enough of even one of the essential amino acids results in the degradation of the muscle proteins in the body. Tryptophan supplements are prescribed for sleeplessness, depression to relieve pain, to regulate appetite, mood and sensory perception but excess of these supplements has many harmful effects (Frances *et al.*, 2011).

Consumption of food containing enough tryptophan can be recommended as a safe source instead of supplements. However, the three fish species in this study can provide tryptophan. Cysteine values were low in this study since most animal proteins are found to be low in cysteine. (Adeyeye and Afolabi 2004; Adeyeye 2005) In this study, the proportion of essential amino acid to non-essential amino acid for the three fish species showed a slight difference (ranging between 0.88 – 0.96), and the highest amount was for *P. obscura* (0.96). However this result has shown a greater amount than the other works: It was 0.78 for *Huso huso* (Kenari *et al.*, 2009), 0.77 for sea bream (*Pagrus major*), 0.77 for Mackerel (*Scomber japonicus*), 0.71 for mullet (*Mugil cephalus*), 0.69 for sardine (*Sardina melonosticta*), 0.74 for herring (*Clupea pallasii*), 0.75 chum salmon (*Oncorhynchus keta*), and 0.77 for pacific flounder (*Paralichthys olivaceus* (Iwasaki and Harada, 1985). However, the result is lower compared to a result reported by Dezhabad *et al.*, (2012) with the following results: Katum (*Rutilus frisii*) (1.19); Silver carp (*Hypophthalmichthys molitrix*) (1.03) and rainbow trout (*Oncorhynchus mykiss*) (1.09).

This may be due to the effect of important variables like season, maturation status and food resources on amino acid composition of fish species.

CONCLUSION

Most people do eat fish for their preferences in consumption mode; while few of them tend to have fishes depending on their nutritional values. Therefore knowing the Amino acids content of commercial fishes should be one of the main elements necessary by consumers for choice type of fish to be eaten. From the results obtained in this study it can be concluded that these three commercially important fish species from Igboho Dam, South-West Nigeria will contribute to the nutritional

qualities and growth of human being as indicated by high protein content and the various amino acid compositions.

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