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# NUTRITIVE AND ANTI-NUTRITIONAL VALUES OF SKINNED EDIBLE BULLFROG *PYXICEPHALUS ADSPERSUS* FOR AQUAFEED

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## ABSTRACT

An investigation on proximate, mineral and anti-nutrition properties of *Pyxicephalus adspersus* was conducted with the view to evaluating its appropriateness as aquafeed source and food source. Standard analytical methods were used to determine proximate, minerals (macro and micro nutrients) and selected anti-nutrients. *Pyxicephalus adspersus* samples were purchased and treated to skinning and oven drying at 60$^{o}$C. Triplicate samples were analysed. The proximate composition showed crude protein content of 34.29%, ash 8.18%, while dry matter, moisture, crude fibre, crude lipid, and NFE were 93.12%, 5.60%, 11.82%, 16.79% and 22.04%, respectively. *Pyxicephalus adspersus* was found to have values (mg/100g) of phosphorus 29.20, calcium 10.60, potassium 4.52, sodium 1.50, and magnesium 1.28. Anti-nutritional compositions (mg/100g) were 5.40, 2.68, 2.06, and 3.05 for tannin, oxalate, saponin and alkaloid, respectively. This result shows that *Pyxicephalus adspersus* could be used as protein source in meeting aquafeed standard without adverse effects. The crude protein (34.20%) content can be used to substitute the most expensive fishmeal in aquafeed and livestock. Also, the carbohydrate content of 22.04% suggests that it is a good source of energy.

**Keywords**: Anti-nutrients, Mineral content, Nutritional content, *Pyxicephalus adspersus*

## INTRODUCTION

Animal protein is an important aspect of nutrient to human and animal which can be obtained from various sources. Fishmeal is one such source for aquafeed. Due to its high nutritional value and proximity to the requirements of the majority of cultured aquatic species, fishmeal serves as the primary source of protein and necessary fats in the preparation of aquafeed (NRC, 2011). The production of fishmeal for human and animal feed is highly competitive, which has put additional strain on world supply and raised market prices (FAO, 2020). Due to aquaculture's heavy reliance on a steady supply of fishmeal, wild fish are under growing pressure to support farmed fish, which has caused the wild stock to rapidly diminish (Stankus, 2021). Since fishmeal is currently in short supply, there is a lot of research being done on substitute protein sources that offer comparable nutritional advantages to fishmeal (Daniel, 2018). Finding protein sources with comparable amounts of essential components is crucial to ensuring aquaculture production is long-term green, economic, and sustainable (GPS) (Daniel, 2018). It has been noted that using unconventional feedstuffs has improved growth and cost-benefit ratios. Due to high cost of fishmeal and health issues associated with red meat, alternative especially from animal which would help to take care of these fishmeal cost and health challenges for safer consumption (Stuart *et al*., 2004). The high cost of commercial animal feed is one of the major limiting factors to the growth and development of agricultural sector in Nigeria (Suleiman, 2019). Tackling the associated exorbitant production cost using non-conventional feedstuff is crucial to the growth and development of agricultural sector in Nigeria. The viability of *Pyxicephalus adspersus* in filling this gap is being investigated. The *Pyxicephalus adspersus* meal can serve as a great source of protein for both fish and human. In regions where fish and other animal protein sources are either scarce or comparatively more costly, edible frogs have been discovered to be proteinous and could serve as an alternative source of animal protein (FAO, 2011) for consumption and aquafeed formulation. Edible frogs include; *Pyxicephalus adspersus, Pyxicephalus eduli, Hoplobatrachus occipital, Trichobatrachus robustus, etc.*

*Pyxicephalus adspersus* (Tschudi, 1838) an African bullfrog, is one of the biggest frogs on earth. This frog is also called pixie frog, from its scientific name *Pyxicephalus adspersus* and the name has nothing to do with pixie but means "round box head", this describes the shape of the frog head. *Pyxicephalus adspersus* is identified as a plump olive-green frog with a big head and mouth and darker skin ridges (Amphibian Special Group, 2014). Sub-Saharan Africa is home to the huge, hostile anuran *Pyxicephalus adspersus*. Africa. The frog is renowned for its remarkable gourmandism, which includes eating little chickens, rodents, snakes, and other frogs (Branch, 1976). *Pyxicephalus adspersus* is widely distributed throughout central part of sub-Sahara Africa, Somalia, Angola, Botswana, Zimbabwe, Zambia, Mozambique, Malawi, Tanzania, Kenya as stated by Channing 1991, in Nigeria and South Africa (Okeyo *et al*., 2014). The species is reported to usually occur in the flooded plains and in a variety of arid and semiarid habitats such as savanna, steppes, bush-lands, and semi deserts (Terry, 2002). *Pyxicephalus adspersus* has been a delicacy to many people (Okeyo *et al*., 2015). Mitchell (2000) reveals that frogs have permissible skin that can allow some toxin to move from skin to flesh. While some authors have examined the species' nutritional composition (Daniel *et al*., 2016: Hatutale, 2022), the anti-nutritional factors of this species have not been examined. According to Douglas and Amuzie (2017), consumers may contract infections as a result of pathogens that are transferred from frog meal. The purpose of this study is to ascertain the sample's nutritional characteristics and ant-nutritional variables.

## MATERIALS AND METHODS

### Purchasing, Identifying and Preparation of Material

The African bullfrog (*Pyxicephalus adspersus*) was obtained from Kwangila market in Zaria Kaduna State and was

identified and authenticated with a cabinet number 3A by Dr. Miss Anele a taxonomist in Department of Zoology, Ahmadu Bello University, Zaria . The samples were skinned with sharp knife, washed in clean water and oven dried at 60ºC for 5 hours. After drying the frog was milled into powder and packed tightly into a plastic container and kept at room temperature for further investigation.

**Proximate Composition Analysis**

The proximate nutrient composition of the sample was determined using recommended methods of analysis of Association of Analytical Chemists (AOAC, 2019).

**Determination of Minerals**

An atomic absorption spectrophotometer was used to identify the mineral composition of the African bullfrog (*Pyxicephalus adspersus*) according to analytical methods of Association of Analytical Chemists (AOAC, 2019).

**Anti-Nutritional Factor Analysis**

The anti-nutritional factors analysis were carried out following standard procedure to determine levels of tannin, saponin, oxalate, alkaloid and phytate present in the sample, according to analytical methods of Association of Analytical Chemists (AOAC, 2006).

**RESULTS AND DISCUSSION**

The outcome of the proximate nutritional composition of *Pyxicephalus adspersus* is presented in Table 1. The following values; 5.60%, 93.12%, 34.29%, 8.18%,11.82%, 16.79% and 22.04% were obtained for CP, ash, moisture, dry matter, crude fiber, crude lipid, and NFE, respectively. The findings demonstrated good protein content of *Pyxicephalus adspersus* diet. This finding for crude protein is in tandem with 31% reported by Mathew *et al*. (2015) for frog (*Pelophylax esculentus*) and 34% reported by Bake *et al*. (2021) for dung beetle larvae meal and 38.49% reported by Ukoha *et al*. (2020). This result obtained in this study is higher than the values 12.04% and 21% obtained in previous studies published by Daniel *et al.* (2016) and Hatutale (2022) respectively. The crude protein result obtained for the skinned *Pyxicephalus adspersus* meal oven dried at 60ºC could be due to heat treatment which denatures when exposed to high temperatures, protein. Denaturization during heat processing can have unanticipated deleterious effects by changing the chemical makeup of protein while lowering its nutritional value (Cagiltay *et al*., 2014). The ash content of the *Pyxicephalus adspersus* meal is 8.18% and this result tandem with 8.93% reported by Mathew *et al*. (2015), 8.33% of maggots meal reported by Ahmad (2022) and compares favorably with 11.82% reported by Burubai (2016) reported for frog *Dicroglossus occipitalis.* This value is expected due the crushing of the frog meat and the bone together. The moisture content of this study 5.60% compares favorably with the value 3.46% reported by Mathew *et al.* (2015) obtained for frog *Pelophylax esculentus*. This moisture content recorded for *Pyxicephalus adspersus* falls below the 12% maximum moisture content prescribed as feed safe storage limit (UNDP & FAO, 1987). Consequently, excessive moisture in meat can increases its susceptibility to spoiling. The lipid content of this result 16.79% was high and in agreement with 16.22% report of Mathew *et al*. (2015). El Oudiani *et al*. (2019) reported that an aquatic animal's lipid content varies with season and is influenced by environmental conditions and the makeup of its diet.

**Table 1: Proximate composition of *Pyxicephalus adspersus* meal (%) as dry**

| **Parameters (%)** | ***Pyxicephalus adspersus meal*** | **Beef ►** | **Beef *FAO** |
|---|---|---|---|
| Moisture | 9.60 | 67 – 68 | 60 – 75 |
| Crude protein | 34.29 | 20.87 - 22.07 | 22 – 30 |
| Ash | 8.18 | 0.86 - 0.96 | 0.9 - 1.2 |
| Crude fibre | 11.82 | - | - |
| Lipid | 16.79 | 6.09 - 7.28 | 1.8 - 2.5 |
| NFE | 22.0 | - | - |

Values are mean ± SEM. n=3, NFE – Nitrogen Free Extract
* Source Datti *et al*. (2020)
►Source FAO (2004)

The outcome of the mineral composition of *Pyxicephalus adspersus* is presented in Table 2. The value 29.28mg/100g was obtained for phosphorus. The value from this study tandem with the study of Cagiltay *et al.* (2014) for *Rana ridibunda*, Mathew *et al*. (2015) for *Pelophylax esculentus* and Atowa *et al.* (2021) for nutritional value of three insects (grasshopper), has similar percentage for phosphorus. The result obtained in this study was higher than the study of Olaleye and Asuquo (2021), but lower than the value reported by Ahmad *et al*., (2022). Phosphorus is an essential mineral component for healthy kidney function and nerve impulse transmission (Igile *et al*., 2013), and is involved in calcification of bone and teeth. It also plays a vital role in the nutrient in form of phosphate (Paiko *et al.*, 2016). The calcium content for this study competes favorable with 7mg/100g for egg white (Sophie *et al*., 2019). Calcium is important for effective development of bone and teeth. It is needed for the formation of muscle, heart and digestive system (Paiko *et al*., 2016). The Fe content (0.87mg/100g) reported this study compares favorably with 1.7mg/100g for egg whole as reported by Sophie *et al*. (2019) and 1.21 mg/100g reported for banana by Mahmoud *et al.* (2023). Fe plays role in the formation of hemoglobin, a protein in red blood cell (Medline Plus, 2024). Potassium value 4.57mg/100g agrees with the report of Ahmad *et al*. (2022), and Shah *et al*. (2022). Potassium plays role in controlling skeletal muscle contraction and nerve impulse transmission (Kubmarawa *et al*., 2007). Nutritional content of aquatic animals tend to vary according to species, season, climate, stage of sexual maturation, and feeding schedule (Cagiltay *et al*., 2014). This validates the findings of this study.

**Table 2: Mineral composition (Macro and Micro) of *Pyxicephalus adspersus* meat (mg/100g)**

| Parameters | *Pyxicephalus adspersus* | Fishmeal |
|---|---|---|
| Ca | 10.63 | 44.8 |
| K | 4.52 | 8.5 |
| P | 29.28 | 28.46 |
| Na | 1.50 | 11.47 |
| Mg | 1.22 | 2.4 |
| Fe | 0.87 | 382 |
| Zinc | 23.25 | 107 |

Values are mean ± SEM. n=3, Ca-calcium, K-potassium, P-phosphorus, Na-sodium, Mg-magnesium, Fe-iron, and Zn-zinc. Source FAO, (2006)

The anti-nutrient result obtained for this study show presences of tannin, saponin and alkaloid, oxalate with the following values (mg/100g) of 5.40, 2.68, 2.06 and 3.04 respectively. The anti-nutritional values of this study are in tandem with the report by Mathew *et al*. (2014) for *Pelophylax esculentus*. The tannin value of 5,40 found in this study is higher than the value reported by Paiko *et al.* (2016). Tannin is known to form complexes with protein under certain pH condition which is responsible for low protein digestibility. Jain *et al.* (2009) reported that 2 - 4% tannin dry matter enhances utilization of nitrogen due to increased bypass protein and concentration more than 7% generally reduces utilization of nutrient. The value of saponin present in this sample was low. Saponin has been reported to contain anti-carcinogenic and immune-stimulatory properties which can reduce the risk of heart disease. The low anti-nutritional finding suggests that it will impair the bioavailability of nutrients less or not at all. This finding demonstrated that *Pyxicephalus adspersus* meal would have no adverse effect on fish and may be utilized as a source of protein for animal nutrition.

**Table 3: Anti-nutrient composition of *Pyxicephalus adspersus* meal (mg/100gm)**

| Parameters | *Pyxicephalus adspersus* meal |
|---|---|
| Tannin | 5.40 |
| Oxalate | 2.68 |
| Saponin | 2.06 |
| Alkaloid | 3.05 |

Values are mean ± SEM. n=3

## CONCLUSION

From this study, *Pyxicephalus adspersus* African bullfrog nutritive properties were analysed using standard method. The analysed samples revealed the presences of protein, ash, lipid, crude fibre and carbohydrate for proximate composition, Fe, Ca, K, Na, P for minerals and some anti-nutrients such as tannin, saponin, oxalate, alkaloid and Phytate. Protein being the most important component of aquafeed, thus the protein content of this animal validates its use in aquafeed production. The result of anti-nutritional factor values obtained indicated that *Pyxicephalus adspersus* will have no deleterious effects on fish body. The information gathered demonstrated that *Pyxicephalus adspersus* has excellent components that can be applied to aquafeed creation and cost reduction. Additional research on sample toxicity, alternative processing and preservation techniques for *Pyxicephalus adspersus* should be carried out. Also further studies need to be conducted to ascertain some medicinal properties of the frog and general awareness for its medicinal importance should be created for the populace.

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