A STUDY OF LOCALLY PRODUCED POTENT FEED FOR HEALTHY FISHES: EMPHASIS ON SOURCES AND COST EFFECTIVENESS

Grace Johnson ETIM Ph.D
Department of Agricultural Education,
Akwa Ibom State College of Education,
Afaha Nsit

And

AFIA, Ofonime Edet
Department of Fisheries and Aquatic Environmental Management,
University of Uyo.
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Abstract

This study investigates the development of locally potent feed for healthy fish and emphasises both the sources and cost-effectiveness. The study delves into key variables such as the importance of fish, effectiveness, and fish feed. By stating the types of locally produced potent feeds, the study aims to formulate a feed that meets the dietary requirements of various fish species. The study underscores the sources and components of locally potent fish and also harnesses local resources to create cost-effective, nutritionally balanced fish feed, paving the way for more resilient and sustainable aquaculture systems. The study concludes that future research should continue to explore and refine these feed formulations to ensure they meet the highest standards of nutritional adequacy and environmental sustainability. One of the recommendations was that collaboration between feed manufacturers, fish farmers, researchers, and non-governmental organisations can foster the development and distribution of locally produced fish feed.

Keyword: Fish feed, Sources, Locally produced and Cost effectiveness

Introduction

The need for fish has increased significantly over the past few decades, and aquaculture has emerged as a critical component in supplying this demand. But the price and accessibility of premium feed is one of the biggest issues facing fish growers. The need for locally made, reasonably priced alternatives arises from the fact that relying solely on imported fish feed can be unsustainable financially in many developing locations. With an emphasis on both the origins and the affordability of the feed, this study intends to investigate the possibilities of locally produced, high-quality fish food.

The reliance on locally available ingredients can significantly reduce the costs associated with fish farming. Various agricultural by-products, such as rice bran, corn gluten, and groundnut cake, have been identified as potential components of fish feed. These ingredients are often less expensive and more accessible to local farmers compared to imported commercial feeds (Olukunle, 2018). Moreover, the use of local resources supports the local economy and promotes sustainable agricultural practices. Economic efficiency is a crucial factor in the adoption of locally

produced fish feed. The cost-effectiveness of these feeds depends not only on the price of raw materials but also on their nutritional value and the feed conversion ratio (FCR). (Musa, 2019).

Nutritional adequacy is another critical aspect of developing potent fish feed. Research has demonstrated that local ingredients such as moringa leaves, cassava peels, and insect meals can provide essential nutrients required for the healthy growth of fish. As stated by Gadzirayi (2012) cited in Asuquo, Eka & Kufre (2021)Moringa oleifera leaf (MOL) contain 25–27% crude protein and high levels of minerals as well as vitamins. The protein of MOLM to be comparable to that of milk and eggs. These ingredients not only offer protein but also contain vitamins and minerals that contribute to the overall health and immunity of the fish (Tacon & Metian, 2017). Maintaining fish health and production requires ensuring the nutritional quality of feed produced locally. With a focus on cost-effectiveness and sources, the investigation of locally produced strong fish feed offers a promising path for sustainable aquaculture.

Concept of fish

Fish are cold-blooded, aquatic animals that live in both fresh and saltwater habitats. They are members of the phylum Chordata and are distinguished by having scales covering their bodies, fins for propulsion, and gills throughout their lives. They can also be described as aquatic vertebrate animals without fingers or toes that have gills. The word fish is derived from an old German form of the Latin word piscus, which is also the name of the astrological sign Pisces. An aquatic, anniotic, gill-bearing vertebrate animal without limbs with fingers that has swimming fins and a hard skull is called a fish. They can be divided into two categories: the more common jawed fish, which includes all extinct placoderms and acanthodians, and the more basal jawless fish, which includes all living cartilaginous and bony fish. Parenti (2024) mentioned that a fish is any of approximately 34,000 species of vertebrate animals. The term fish refers to a variety of vertebrates from several evolutionary lines. It describes a life form rather than a taxonomic group.

Purswani (2023) stated that fish are divided into three, namely, Agnatha, Chondrichthyes, and Osteichthyes. Purswani further explained that fish are not amphibians, as they respire through gills and contain only fins as their appendages, and also not mammals, as they do not have mammary glands like mammals and do not breastfeed their young ones. Fish occur in numerous sizes, shapes, colours, and forms, as the most common features they possess are streamline bodies, scales on skin, fins, and grills. They can also live in a wide range of aquatic habitats as they have developed adaptations to acclimatise themselves to a wide range of temperatures, pressures, and light conditions.

Furthermore, fish reproduce using sperm and eggs in a manner similar to other vertebrates. Both external (water) and internal (mating) fertilisation are possible. All fish are vertebrates, with vertebrae protecting the spinal cord; they live in water; they breathe primarily through their gills rather than their lungs; they have paired limbs called fins that help with locomotion; they are unable to regulate their own internal body temperatures; and they are covered in scales that protect their bodies. All fish have a brain protected by a braincase and an obvious head region with eyes, teeth, and other sensory organs.

Concept of fish feed

A fish's nutritional demands for growth, health, and reproduction are met by the specific food called fish feed, which is fed to fish in aquaculture environments. Asuquo, Eka & Kufre

(2021) mentioned that nutrition is one of the major factors in improving the production efficiency of fish. Other factors include these fishes' growth, health, body color, and breeding. Additives included, it is also the material or product meant for oral feeding in fish culture systems that produce fish for human and animal consumption, regardless of how processed, partially processed, or unprocessed it is. Fish feed provides the energy and vital nutrients that fish, especially prawns and prawns, require for development, maintenance, and regular metabolic processes. Natural food sources or fish farmers can provide fish feed. Bygora (2021) defined fish feeds as an integral part of commercial and personal aquaculture, which provides a balanced diet and nutrition for farmed fish. Bygora further stated that the aquaculture feed is mainly in pellets or granules, thus providing wholesome nutrition in a concentrated and stable form, allowing the fish to feed well and grow to their maximum potential. Moreover, a fish feed is typically composed of proteins, fats and oils, carbohydrates, additives, vitamins, and minerals.

According to Hardy & Brezas (2022), formulating a fish feed involves selecting a combination of ingredients that results in a mixture containing levels of essential nutrients that meet or exceed the minimum requirements of the fish. Fish feed is a mixture or compound of various ingredients that meet the nutritional requirements of fish. However, the fish feed can be categorised based on various factors, which include starter feeds, grower feeds, and finisher feeds. Yossa (2021) mentioned that access to sustainable and affordable fish feeds is a key determinant of productive and profitable aquaculture. Furthermore, the formulations of fish feed vary based on the species being cultured, their stage of growth, water temperature, and desired market outcomes, as the feed could be pelleted, extruded, or powdered.

Concept of effectiveness

The capacity to generate a desired outcome or the ability to accomplish a desired result is what is meant by effectiveness. The Latin word effectivus, which meaning efficacy, is where the term effectiveness originates. Reaching goals and completing tasks are the main components of effectiveness. It can also mean having the capacity to succeed and deliver the desired outcomes. Effectiveness takes into account if the final goals are truly achieved in addition to efficiency, which only considers how resources are employed. Poskart (2014) mentioned that effectiveness is understood as the ability of such an organism to obtain resources from the environment and utilise them in order to function and develop. Effectiveness is also a measure of success in achieving a clearly stated objective, as it is also measured by impact assessments, benchmarking, indicating key performance, and feedback. Moreover, effectiveness typically describes things such as policies, treatments, arguments, and techniques used to do what is intended to be done.

Erlendsson (2002), cited in Harvey (2024), defines effectiveness as the extent to which objectives are met (doing the right things). Harvey further defined effectiveness as the extent to which an activity fulfils its intended purpose or function. Furthermore, people can also be described as effective when they accomplish what they set out to accomplish. Effectiveness also describes the ratio of achieved goals to pursued goals and can be used for work processes, procedures, and personal performance. It is about whether the desired results are achieved and how well they are achieved. Effectiveness is a metric for achievement and productivity that is widely applied in a variety of industries, including business, healthcare, education, and engineering. It is important for both individuals and corporations in many different contexts. According to Droege (2022), effectiveness is defined as the extent to which planned activities are realised and planned

results are achieved. Additionally, effectiveness consists of goal achievements, outcome measurement, adaptability, and sustainability.

Types of locally produced potent feed for healthy fishes

For fish to grow healthily in aquaculture, high-quality, nutrient-rich feed is necessary. In addition to providing fresh, well-balanced nutrition, locally produced feed options also support sustainability. Here are some potent types of locally produced fish feed:

Aquatic Plants

***Duckweed (Lemna spp.)*:** Rich in protein, duckweed grows quickly and can be used fresh or dried.

***Azolla*:** This water fern is nutrient-dense, providing proteins, amino acids, and minerals.

Insect-Based Feed

***Black Soldier Fly Larvae (BSFL)*:** High in protein and fat, BSFL can be grown on organic waste, making it a sustainable feed option (Lalander, 2019).

Housefly Maggot Meal: Another protein-rich option, housefly maggot meal has shown promising results in fish growth and health studies.

Agricultural By-products

Rice Bran: A by-product of rice milling, it is rich in fats, proteins, and vitamins.

***Brewer's Spent Grain*:** This by-product from brewing is high in fibre and proteins and can be dried for fish feed (Oliva-Teles, 2012).

Soybean Meal: Processed from locally grown soybeans, it is an excellent protein source.

Fermented Feed

***Fermented Fish Silage*:** Made from fish scraps, this feed is nutrient-dense and enhances fish health.

Microalgae

Spirulina is a superfood rich in proteins, vitamins, and antioxidants.

Chlorella is nutrient-packed; it boosts fish immunity and growth.

Organic Waste

Vegetable and Fruit Scraps: Properly processed scraps can provide essential vitamins and minerals. As noted by Aja (2013) cited in Asuquo, Eka & Kufre (2021) vegetables contain water soluble vitamins like vitamin B and vitamin C, fat soluble vitamins including vitamin A and D and also contain a great variety of phytochemical constituents which have being claimed to have antioxidant, antibacterial, antifungal, antiviral and ant carcinogenic properties

Food Waste: Converted into fish feed through composting or fermentation, ensuring it is safe and nutritious.

Sources of locally produced potent feeds for fishes

Due to the increasing importance of aquaculture in the world's food production, effective and sustainable feed sources are required. Robust meals, made locally, are crucial to promoting fish growth and preserving the ecosystem. Use of strong feeds generated locally is essential to fish development that is sustainable. Below are the sources of locally produced potent feeds for fish:

Plant-Based Ingredients

Soybean Meal

One of the most popular plant-based proteins used in fish diets is soybean meal. It's a great substitute for fish meal because of its high protein content and advantageous amino acid composition. Fish development and health can be preserved by substituting a sizable amount of soybean meal for fish meal. According to Kumar (2020), incorporating soybean meal into fish diets can improve growth performance and feed utilisation efficiency in several fish species, including tilapia and catfish.

Agricultural By-products

The possible use of agricultural by-products in fish diets, such as rice bran, wheat bran, and maize by-products, has been studied. These ingredients are inexpensive and readily available in the area. El-Sayed and Gaber (2018) stated that rice bran could be included in the diets of Nile tilapia, resulting in satisfactory growth performance and nutrient utilisation.

Animal-Based Ingredients

Poultry by-product meal

Poultry by-product meal is a high-protein ingredient derived from the rendering of poultry offal. It has been found to be an effective substitute for fish meal in aquafeeds. Dawood and Koshio (2019) mentioned that poultry by-product meal could replace up to 50% of fish meal in the diet of rainbow trout without compromising growth and feed efficiency. As mentioned by NRC (1994) cited in Asuquo, Eka & Kufre (2021) Poultry are efficient converter of feed into useful products such as meat and eggs. They have high metabolic rate which require high nutrient feeds. Poultry require about 38 dietary nutrients in the right proportion.

Insect Meal

Insect meal is emerging as a sustainable protein source for fish feeds. Black soldier fly larvae (Hermetia illucens) and mealworms (Tenebrio molitor) are among the most studied insects for this purpose. Insect meal can significantly enhance growth performance and nutrient utilisation in various fish species. Nogales-Mérida (2019) pointed out that black soldier fly larvae meal could effectively replace fish meal in the diet of Atlantic salmon, leading to comparable growth rates and feed conversion ratios.

Algal Ingredients

Microalgae and macroalgae are gaining attention as alternative feed ingredients due to their high nutritional value. Spirulina (Arthrospira platensis) and Chlorella spp. are commonly used microalgae in fish diets. Spirulina could enhance the growth and health of juvenile Atlantic salmon when included in their diets (Tibbetts, 2016).

Fermented Products

Fermentation enhances the nutritional quality and digestibility of feed ingredients. Fermented soybean meal and fermented plant by-products have been successfully used in fish feeds. Wang (2017) highlighted that fermented soybean meal improved the growth performance and intestinal health of grass carp.

Components of locally produced potent feeds for fishes

The development of locally produced, potent fish feeds involves incorporating a variety of ingredients to ensure optimal growth, health, and sustainability in aquaculture. Here are the key components of locally produced, potent feeds for fish:

Additives: These include vitamins, minerals, and immune stimulants to boost fish immunity and overall health. Betaine, for example, is used to mitigate heat stress and improve feed conversion rates (Singh, 2022). On the other hand, it was noted that Moringa olleifera could partially replace animal protein sources such as fish meal thereby reducing the cost of feed production which will in turn increase the farmer's income Nuhu,(2010) cited in Asuquo, Eka & Kufre (2021).

Sustainability and Local Availability: Utilising locally available ingredients helps reduce costs and supports local economies. It also minimises the carbon footprint associated with the transportation of feed ingredients (International Scholars Journals, 2020).

Protein Sources: These are crucial for fish growth and can be derived from fish meal, soybean meal, and non-conventional sources such as insects and microalgae. Insects, for instance, provide high protein content and are sustainable and cost-effective.

Plant-based components: These include oilcakes made from mustard, groundnut, and soybean, which serve as protein sources. Plant-based ingredients are increasingly favoured for their sustainability and lower environmental impact compared to traditional fish meal (Pharma Journal, 2020).

Microalgae: Microalgae like Spirulina and Chlorella are rich in proteins, essential fatty acids, and vitamins. They are used to enhance the nutritional quality of fish feeds and improve fish health and growth rates. They also play a role in bioremediation and reducing the environmental impacts of aquaculture (Han, 2019).

Cost effectiveness of locally produced potent feeds for fishes

Over the past few decades, the aquaculture or aquafarming business has grown significantly, mostly as a result of the rising demand for fish protein worldwide. The feeding plan used in aquaculture is an important factor that impacts growth performance, sustainability, and total production costs. Strong feeds made locally present a viable substitute for feeds made commercially, particularly in emerging nations where fish farming is quickly growing.

Cost Reduction: One of the primary advantages of locally produced feeds is the potential for cost savings. Locally sourced ingredients can reduce transportation and importation costs associated with commercially manufactured feeds. Utilising local feed resources can lead to significant reductions in production costs. Abass (2020) noted that substituting imported feed with locally sourced ingredients could decrease feed costs by up to 25% without compromising growth performance in tilapia farming.

Nutritional Benefits: Locally produced feeds can be formulated to meet the specific nutritional requirements of local fish species. This adaptability can enhance growth rates and feed conversion efficiency. According to Pahlow (2021), locally produced feeds that utilise regional ingredients tend to have a higher bioavailability of nutrients, which positively impacts fish health and growth.

Sustainability: The use of local ingredients helps promote sustainability in aquaculture. Utilising local agricultural by-products and fish waste reduces the environmental impact associated with feed production. Bostock (2016) emphasised that incorporating local resources contributes to a circular economy in aquaculture, which can help mitigate the pressure on wild fish stocks.

Empowerment of Local Farmers: Producing feed locally can empower smallholder farmers by reducing dependence on external feed suppliers. It can also create local jobs and stimulate the local economy. Harun (2018) mentioned that community-based feed production initiatives increased local employment and improved food security in rural areas.

Types of fishes raised in Akwa Ibom State

Akwa Ibom State, located in the coastal region of southeastern Nigeria, has a rich aquaculture industry primarily focused on various fish species. The main types of fish raised in this region include:

Catfish (Clarias gariepinus)

Catfish farming is highly prevalent due to the fish's adaptability to local conditions and its high market demand. Catfish are known for their fast growth rates and resilience, making them a staple on many local fish farms (Essien, 2017).

Tilapia (Oreochromis niloticus)

Tilapia is another widely farmed species in Akwa, Ibom. It is favoured for its rapid growth, ease of breeding, and popularity among consumers. Tilapia farming is often integrated with other agricultural activities, promoting sustainability (Bassey, 2018).

Mudfish (Heterobranchus)

Mudfish are highly valued in the region, especially for their size and taste. They are often farmed in combination with catfish to optimise pond use and water resources (Ekpo, 2020).

Bonga Fish (Ethmalosa fimbriata)

Bonga fish, commonly caught in the wild, are also farmed in brackish aquatic environments. They are essential for local diets and are processed into various traditional foods (Frank, 2019).

Mullet (Mugilidae)

Mullet species are cultivated in both freshwater and marine environments. They are appreciated for their flavour and are an important part of the local cuisine (Okon, 2020).

African River Prawn (Macrobrachium vollenhovenii)

While not a fish, the African river prawn is also farmed in the region. Prawn farming is becoming increasingly popular due to its high market value and the relatively low environmental impact of farming practices (Udoh, 2021).

Conclusion

Locally produced potent feed for healthy fish presents a multidimensional opportunity to enhance the sources and cost effectiveness of aquaculture. By leveraging local resources, farmers can achieve substantial cost savings, support their communities, and contribute to global sustainability goals. Future research should continue to explore and refine these feed formulations to ensure they meet the highest standards of nutritional adequacy and environmental sustainability. This approach not only benefits fish farmers but also contributes to the broader objective of sustainable food production systems.

Recommendations

1. Continued research is essential to identify and optimise local ingredients that can be used in fish feed formulations. This includes studying the nutritional profiles of various locally available ingredients, understanding their effects on fish health and growth, and developing balanced feed formulations.
2. Governments and policymakers should provide support through subsidies, grants, and tax incentives for the production and use of locally sourced fish feed. Policies that promote the sustainable use of agricultural by-products and other local resources can help reduce the cost of raw materials.
3. Educating fish farmers about the benefits and methods of using locally produced fish feed is crucial. Extension services, workshops, and training programmes should be established to disseminate knowledge about the nutritional value, formulation, and economic advantages of local feeds.
4. Collaboration between feed manufacturers, fish farmers, researchers, and non-governmental organisations can foster the development and distribution of locally produced fish feed. Establishing cooperative models or associations can help small-scale farmers access high-quality feed ingredients and share best practices.

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