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Literature Review Paper

Fish Feed Additive from the Extraction of Herbs Materials: A Review

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Abstract: Feed additives are now starting to become a necessity as additional feed in fish feed formulations that are deliberately added in order to affect feed characteristics and fish growth. Some good herb ingredients from the rhizomes (roots), stems, leaves, and fruit by means of extraction, both physically and chemically, which aims to obtain active ingredients. The resulting extracts can be in the form of flour, liquid extracts, and thick extracts. This paper is in the form of a review of several research results regarding the manufacture of herb extracts and their use in fish. Alternative sources of herb ingredients as feed additives with active ingredients in feed can increase feed quality through antioxidant mechanisms or herb antibiotics in increasing productivity.

Keywords: Antibiotics; Antioxidants; Extractions; Feed Additives; Herbs.

Introduction

Fish feed is one of the important things in the success of cultivation, which is determined by the provision of good-quality feed (Bharati et al., 2019; Haetami et al., 2022). The quality of a feed is usually determined by the protein and amino acid content in it. Feed is the most important source in the activity or process of implementing aquaculture aimed at supporting the survival and growth of the fish itself (Sanz, et.al., 2000; Martin, et al., 2022). Feed requirements in one cultivation cycle range from 60-70% of the total production cost, especially when using commercial feed. Fish feed is said to be of high quality if it contains the nutritional value needed by fish. According (Darmawiyanti et al., 2015). Fish feed for fry and fingerlings with a food habit that tends to be carnivorous is expected to contain 35% - 70% protein, while 15% carbohydrates, 10% fat, and 5% vitamins, water, and minerals.

The high cost and the declining quality of the feed are currently obstacles in the cultivation process. Another obstacle encountered in aquaculture activities is fish health problems, which cause livestock or fish to be susceptible to disease, due to an imbalance between the environment, interactions between biological organisms, and the development of disease-causing pathogen. Several studies have been directed at the use of natural ingredients, both from plant and animal extracts, or microorganisms, to replace the role of chemicals used as immunostimulants (Kurniawan, et.al., 2020). Disease prevention by taking preventive measures, one of which is using materials that function as immunostimulants, especially in the seed stage, to increase body resistance.

The use of natural materials that are environmentally friendly, easy to obtain, cheaper, and have minimal side effects, among others by adding feed additives from plants or herbals intended as a source of nutrition in feed, but their use is an alternative to improve feed quality.

Feed additives are intentionally added because they can affect the characteristics of feed or fish products. Feed additives from extracted herbal ingredients are alternatives that can be used to increase the beneficial value of feed, as well as other types of feed additives such as probiotics, enzymes, acidity regulators, minerals, vitamins, and other ingredients, depending on the intended use and method of

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use (Kurniawan et.al., 2020). The addition of feed additives to the feed aims to obtain optimal fish growth. According to the International Standard class of feed ingredients (Bharati et al., 2019), what is meant by additives that do not contain nutrients, and are distinguished from feed supplements as additional ingredients that contain complementary nutrients, both belong to class VIII of feed ingredients, namely feed additives.

Several examples of feed additives commonly given to fish include antibiotics, phytobiotics, amino acids, enzymes, hormones, and dyes. Furthermore, according to the use of active ingredients, polyphenolic compounds from plant extracts are useful as feed additives (Abun et al., 2021). In cultivation activities in the green economy era, this can be used as an environmentally friendly material. The use of plants from the rhizome (roots), stems, leaves, and fruit can be an alternative, because according to Kurniawan, et al. (2020) sources from plants or herbal ingredients that are biodegradable and environmentally friendly are also easy to find in nature. The purpose of writing this review is to identify several types of herbal ingredients that are commonly used and their manufacturing processes so that they can be used as feed additives.

Materials and Methods

Research Design

This study used a literature review method with a descriptive approach to identify herbal materials, extraction methods, active compounds, and their applications as feed additives in fish. The review was conducted by collecting, analyzing, and summarizing previous studies related to the utilization of herbal extracts in fish feed formulations.

Data Sources and Literature Search Strategy

The data used in this study were secondary data obtained from scientific publications, including research articles, review articles, books, and other relevant scientific sources related to herbal extraction and its application as feed additives. Literature searches were conducted using keywords such as “herbal extraction”, “herbal feed additive”, “fish feed additive”, “phytogenic feed additive”, “antioxidant herbal extract”, and “antibiotic herbal extract”.

Literature Selection Criteria

The selected literature was based on its relevance to the study topic, including studies discussing (1) herbal materials derived from rhizomes, leaves, stems, fruits, or other plant parts, (2) extraction methods used for herbal preparation, (3) bioactive compounds contained in herbal extracts, and (4) effects of herbal supplementation on feed quality, fish growth performance, health status, or immune responses. Publications unrelated to herbal utilization as feed additives were excluded.

Data Analysis

The collected data were analyzed descriptively by categorizing information based on herbal sources, extraction methods, active compounds, mechanisms of action, and biological effects on fish. The results were presented in the form of descriptive explanations and tables to illustrate the potential of herbal materials as alternative feed additives in aquaculture.

Results and Discussion

Extraction Process Of Several Types Of Herbs

Herbals are widely used because they have several factors and advantages when compared to synthetic chemical drugs, several factors and advantages in using good quality herbal (Mustafa and Al-Faragi, 2020). The first thing to do in the process of making a feed additive for herbal ingredients is to mechanically or physically process them, using simple tool instrumentation or using tools or machines such as chopping and hammer mills. The purpose of the mechanical process is as a preconditioning or to obtain a dry preparation called simplicia so that it can be easily processed later, namely the chemical extraction process.

Extraction according to Lakmini et al. (2022a), namely the process of separating and isolating substances from a substance by adding a solvent. Extraction is a method used to separate the components of plant chemical compounds using solvents that differ in solubility between one substance and another to remove mixed components from solid or liquid substances (Kusmayadi et al., 2019; Haetami et al., 2021). In this case, the desired solid fraction is soluble in the solvent, while the other solid fractions are insoluble (Sanz and Higuera, 2000; Lakmini et al., 2022a).

The principle of extraction is the transfer of the extracted substance components into the

solvent, where the transfer begins to occur at the interface layer, and then diffusion occurs to enter the solvent (Lakmini et al., 2022b, Hamdi *et al.*, 2024). The purpose of herb extraction as a feed additive provider, according to Haroen and Budiansyah (2019). Some herb plants contain components that act as anthelmintic, anti-catarrhal, anti-emetic, anti-inflammatory, antibacterial, antifungal, laxative, aromatic, diuretic, stimulant and others. Extraction can be done physically, chemically, and Biologically. From this definition, the following are some examples of making feed additives from herb ingredients.

Herbs Rhizome Extraction

One of the herbal ingredients from rhizomes is turmeric, which was tested as a phytopharmaceutical with the target ingredient being fresh turmeric rhizomes. The extraction dose was 1:10 (w/v), using water, 70% alcohol, and 96% alcohol as solvents. Treatment with water solvents used warm water immersion (infusion, temperature around 70 °C and deoxy (boiling, temperature around 90 °C) for 15 minutes, while 70% and 96% alcohol solvents used the maceration method for 24 hours (Lili, et.al., 2022). According to research results (Nurhasnawati et al., 2017). The use of 96% alcohol solvent is able to withdraw the active ingredients to the maximum.

Plants that can be used as supplements include turmeric and ginger (Ampode and Lagua, 2021) revealed that turmeric contains several compounds including essential oils, turmerone, zingiberin, protein, carbohydrates, fat, vitamin C, iron, phosphorus, magnesium, alkaloids, flavonoids, tannins, resins and curcumin. The turmeric that was tested as a phytopharmaca in this study was fresh turmeric rhizome. The extracted dose was 1:10 (w/v). Solvents for extraction include water, 70% alcohol and 96% alcohol. Treatment with water solvents used warm water immersion (infusion, temperature around 70 °C) and deoxy (boiling, temperature around 90°C) for 15 minutes, while 70% and 96% alcohol solvents used maceration method for 24 hours (Nurhasnawati, et.al., 2017; Pratama, Sulmartiwi and Rahardja, 2017). Furthermore, according to (Ampode and Lagua, 2021), the curcumin solution was added to the feed, namely the turmeric curcumin extract product was weighed according to the treatment dose (0.5 g, 0.7 g, 0.9 g). Then put it in a beaker glass which has been filled with 100 ml of distilled water. Heat it on a hot plate with a temperature of 40-600C and stir it using a spoon so that it is homogeneous. After it is hot and the solution is homogeneous, the curcumin solution can be added to the feed mixture.

Essential oil

Making essential oils as a feed additive obtained from herbs ingredients of garlic bulbs (Rahmi, et.al. 2014; Singh et al., 2017). The garlic is extracted in a laboratory with a procedure that includes: taking the appropriate size garlic, then chopping it and drying it in the oven. Furthermore, chemical extraction is carried out using a soxhlet extraction tool to obtain a thick extract and cool it in an incubator and then weigh it and then filter it on filter paper 0.1 or you can also use cotton so that the garlic litter does not dissolve in the essential oil.

The process of mixing feed additives in feed

In the process of mixing feed additives into the feed, it can be done during the pelleting process. Formulated ingredients, such as fish meal, soy flour, wheat flour, vitamin and mineral mix, fish oil are weighed as needed. The mixing of the ingredients is carried out in stages, starting from the smallest to the largest amount until the mixture is homogeneous. Furthermore, the homogeneous material is added to the curcumin solution which has been heated according to the treatment dose, then added water that has been cooked (not too hot) is added, up to 30-35% of the total weight of the material. The addition of water is done while the ingredients are stirred evenly so that lumps can be formed. Then the pellets are printed with a pellet press, then the pellets are dried by drying them in the sun. After that the finished pellets are stored in plastic or jars.

Several Uses Of Herbals Materials As Feed Additives

Herbal plants can be classified based on the content of active substances such as alcohol, alkaloids, anthraquinones, bitters, cardiac glycosides, coumarins, flavones, flavonoid glycosides, phenols, saponins, tannins, and volatile oils (Bharati et al., 2019; Kusmayadi et al., 2019). The following is a table of research results regarding the mafacture of feed additives from the chemical extraction of herbals ingredients. Table 1, shows that there are several examples of feed additive sources and how to make them by showing the active ingredients and

their function.

Table 1. Several Types of Herbs Feed Additive Sources

Herbals	Making Extract	Compound active	Function	Refferences
Quixalud	Halquinol 60% dan calcium carbonate 40 %	Quixalud	Improve	Rachmawati, (2006)
Tumeric	Flour milling	Curcumin	Antioxidant	Santika, *et.al*, (2021)
Cilembu sweet potato	Manufacturing of prebiotics	Prebiotic oligosaccharide	Improve digestive	Pangaribuan, *et.al*., 2018)
Garlic *(Allium Satiuum)*	Making astiri oil	querticin	Antibiotic	Rahmi, *et.al*., 2014)
Clove oil	Destilation	eugenol	Antibiotic dan Antioxidant	Pratiwi, et.al, 2015)
Bandotan leaf (*Ageratum conyzoides*)	Destilation	Essential oil and saponin	Antioksidant, decreased stress and aspec sedative	Pratama, *et.al*., 2017)
Azolla meal	Fermentation with *T. harzianum*		Antioksidant, quality increased	Utomo & Nurfadhilah, 2011))
Moringa leaves meal	Fermentation with *A. niger*	moringa leaves meal	Antioxidant	Putra *et al.*, 2020)
Noni leaf extract (*Morinda citrifolia*)	Soaking	flavonoid, terpenoid, antrakuinon, alkaloid, and saponin	Antibiotic	Hamballi e*t al*., (2019)
White garlic and black garlic	Sliced, dried, and extracted using a water solvent.	sulphur aliin, allicin, disufide, lysine and atsiri oil	Antibiotic and antioxidant	Ramirez *et al.*, (2017); Pangaribuan et al. (2022)

The use of herbal plants is one of the alternative developments with the aim of increasing growth performance, health, and even the immune system of fish. Extraction from biological material tends to be cheaper, easier to prepare, and biodegradable (Muxika et al., 2017). The use of herbals and plant extracts or their combinations has been known in vivo and in vitro as an appetite enhancer, growth promoter, antimicrobial, antiparasitic, and antioxidant (Sari, 2016; Liu et al., 2022), and immunostimulating effects (Karimi et al., 2018; Ahmadifar et al., 2021). Some applications of using herb ingredients in fish can be seen in Table 2.

Table 2. Several Results of Fish Feed Additives from Herbal Materials

Herbs	Dose	Results	Refference
A.membranaceus, P. multiflorum Thunb., *Aristolochia* L., *I.s tinctoria* L., and *G. glabra*	0,5 % or 1%	Herbs Immunogenregulation Mixture (HIRM) treatment is able to modulate several immune parameters in goldfish (*Cyprinus carpio*).	(Yuan *et al.*, 2007)
Rosemary (*Rosmarinus officinalis*) and Aloe barbadensis	rosemary 0.1, 0.25 0.5% and aloe vera 0.5, 1.0, 2.5%.	At 90 days of administration, it does not have a negative effect on tilapia metabolism, and the best is the addition of Rosemary extract 0.1%.	(Yılmaz *et al.*, 2019)
Licorice (*Glycyrrhiza glabra*) with compound flavonoids and glycyrrhizin	0.1, 0.2, or 0.3 g/L	As a curative with high prevalence, anti-inflammatory and improves immunity, organ development, growth appetite, and reduces total serum cholesterol in broilers.	(Alagawany *et al.*, 2019)
White garlic (*Allium sativum*)	15 ppm, 20 ppm, and 25 ppm	Giving a dose of 20 ppm essential oil from garlic injected into carp is quite effective in controlling A.hydropila infection..	(Rahmi, Darmawan and Abil, 2014)

Herbs	Dose	Results	Refference
White garlic and black garlic	@ 10 mL into 1 kg of feed then allowed to stand for ± 10 minutes before being given to catfish	The addition of white garlic extract to the feed gave the best results with a length growth	(Pangaribuan and Yonarta, 2022)
Clove oil	Compound active : eugenol 58,27%, metil eugenol 0,41% β karyophilene 31,29%	Giving clove oil as much as 10 mg/100 g of feed can increase feed efficiency and protein retention, with the same growth rate as treatment without the addition of clove oil.	(Silvianti, et.al. 2016)
Bantotan leaf extract (*Ageratum conyzoides*)	Astiri oil 15 ppm	Has potential in the aspect of sedation in transportation, speeding up fainting time and slower recovery time.	(Pratama, et.al. 2017)
Noni leaf (*Morinda citrifolia L.*)	ekstract 2,5 g, 5 g, 7,5 g and 10 g.	Curative dose of 5 g/kg of feed from Aeromonas bacterial infection with 79.17% survival, 1.99% growth rate and improves feeding response and internal organs	(Hamballi, *et.al*., 2019)
Quixalud	0 mg/kg; 15 mg/kg; 30 mg/kg and 45 mg/kg	The addition of quixalud in the artificial feed of 30 mg/kg of feed gave the best growth, feed conversion ratio and survival of tiger grouper fry.	(Rachmawati, 2006)
Cucumin extract	0, 10, 15 and 20 ml/kg	A dose of 20 ml / kg of artificial feed increases the growth and feed efficiency of barramundi (*Lates calcarifer*).	(Santika, et.al., 2021)
Astragalus radix	0; 0.1; 0.5 and 1.0%	The optimal dose is 0.1% and 0.5% with an optimal feeding period of 3 weeks.	(Yuan *et al.*, 2007)
bulb garlic powder	oxytetracycline (AB), 1.0, 1.5, and 2.0% of garlic powder (GP)	1.5% sun dried GP can be used as an alternative to antibiotic growth promoters in broilers	(Singh *et al.*, 2017)
Clove basil leaves extract (CBLE)	diets enriched with 0.0, 5, 10, or 15 g CBLE/kg diet for 12 weeks.	CBLE administration enhanced the performance, feed utilization, antioxidant, and innate immunity properties of African catfish with an optimum level of 12 g/kg diet	(Abdel-Tawwab *et al.*, 2018)
Grape extract (Vitis vinifera) pomace	20, 40, and 60 g GP / kg diet for 42 day	growth performance, blood metabolites, immunity, antioxidant status, and intestinal morphology of heat-stressed broiler chicken	(Hosseini-Vashan *et al.*, 2020)

Herbals in general can act as antioxidant and antibiotic.

A study conducted by (Salomón et al., 2020; Rosidah et al., 2021) suggested that various chemical compounds present in herbals plants have antioxidant effects that can help organisms deal with oxidative stress by damaging free radicals. The antioxidant effect also improves the physiological condition of fish in general. A side from being antioxidants, Aloe vera herbal extract have been also known to an antibiotic function which are known to be able to treat ectoparasitic problems in fish and have been used to treat several parasitic diseases such as myxobolasis, trichodiniasis, gyrodactylosis, argulosis, and skuticochilia in cultivated fish (Rosidah et al., 2021). This is proven by research by (Abdel-Tawwab et al., 2018), in fish infected with pathogenic bacteria A. hydrophila after 12 weeks of being fed with green tea (*Camellia sinensis)* additives showed an increase in weight in tilapia (*O. niloticus*), which indicated that green tea was added to the feed.

Conclusion

The addition of herbs ingredients to feed from their function mechanism as antioxidants and antibiotics is considered to be able to increase the growth and health of fish. The addition of herb ingredients as a feed additive in feed can increase productivity, product quality and health, as well as affect the environment in the scope itself.

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