

Non-conventional feed Ingredients

Introduction

- Many other ingredients have potential in aquaculture feeds; their value has not yet been fully evaluated.
- Some of these ingredients are referred to as “unconventional” or “non conventional” feedstuffs.
- Non-conventional feed ingredients are not usually the traditional ingredients used for commercial fish feed production.
- Fishmeal is known to contain almost complete EAA profile that is needed to meet the protein requirement of most fish species.
- Since fishmeal is becoming expensive as a feed ingredient, the use of non-conventional feedstuffs has been reported with good growth and better cost benefit values.

- This group of feedstuffs includes leaf protein concentrate, seaweed, by-products of sugar cane, by-products of fermentation processes, microbial proteins, algae, manures and celluloses

Seaweeds

- Seaweed meals are of value in aquaculture diets, particularly in those for shrimp.
- They are a source of trace minerals and vitamin A and probably increase palatability.
- Shrimp are able to digest cellulose better than fish

Manure

- Animal manures can be used in fish and shrimp feeds in addition to their use as manures
- However, over 50 % of the crude protein of manures consists of non-protein nitrogen, such as uric acid.
- Use of small quantities of poultry manure in shrimp feeds was found successful and tilapia was experimentally fed with a trout feed having up to 30 % dried poultry waste in it, without any depression of growth rate

Microbial proteins

- Bacterial proteins, grown from aqueous solutions of mineral salts with a nitrogen source, using methane as an energy source, and yeasts (mostly 'torula' or fodder yeasts) grown on paraffins and industrial wastes such as molasses, sulphite waste liquor from the paper industry, fruit wastes, etc., are becoming increasingly available as ingredients for animal feeds
- Both types, especially the bacterial type, are rich in protein.
- The amino acid profile varies according to the type and the media on which it is grown.
- Some yeast is particularly deficient in methionine, while some are very high in lysine level.

Bacterial protein

- Bacterial protein is among the single-celled proteins (SCP) that have received increasing attention in recent years
- *Methanomonas* spp. Is cultured in an aqueous suspension containing mineral salts and a nitrogen source
- A mixture of methane and air is bubbled continuously through the suspension.
- The bacteria has high protein content, a good portion of which is nucleo-protein.

- Although its production may be feasible in countries which have a surplus of methane, the cost of the product is presently high.
- Studies on its use in fish feed are not conclusive although there are indications that it is superior to other SCP such as yeast and algae.

Algae

- Dried unicellular algae like microbial protein, sometimes referred to as single cell protein (SCP) (mostly *Chlorella*, *Spirulina* and *Scenedesmus* Species)- are high in protein but usually too expensive for use in animal feeds.
- Those fed alive to larval aquaculture stock are especially cultured.
- Algae are rich in carotenoids

- The production of algal blooms and benthic algal complexes through fertilization and water management has been long practiced in Asia.
- Certain species of *Chlorella*, *Scenedesmus* and *Spirulina* have been established as excellent feed for larvae of many cultured species of fish.
- *Scenedesmus obliquus* has been tested quite extensively in carp and found to be good substitute for fish meal

Yeast

- The most commonly used and widely available SCP for animal feeding is torula yeast (*Candida utilis*)
- This is cultured on the substrates comprising a variety of industrial wastes, including :
mollases, dried citrus pulp or sulphite liquor from the wood pulp and paper industries.
- The harvested yeast is usually dried over steam-heated drum rollers

- Petroleum yeasts (*Candida lipolytica*) have higher feeding value than yeasts made from molasses (*C. utilis*)
- Yeasts, like bacterial proteins, are rich in nucleic acids which limit its use as food for humans
- Whether this applies also to fish has not yet been determined

Leaf protein concentrates

- Leaf protein concentrate is produced by first grinding the plant leaves and separating the juice by pressing.
- The juice, which contains the dissolved protein, is then coagulated by heating.
- The curd obtained is removed and dried
- LPC made from the genera *Leucaena* and *Mimosa* contains toxic mimosine, a cyclic amino acid.

- Leaf protein concentrates can be produced from the leaves of tropical legumes such as the *Acacia* and *Desmodium* species and from grasses.
- Leaf protein concentrate from rye grass used at levels of up to 48 % of total dietary protein have been successfully tested on carp and trout.

Cane Molasses

- This diluted by-product of cane sugar refining can be used as a partial source of energy, as “filler”, as a binder and as a possible attractant.
- It is cheap and widely available, except where fermented for alcohol production
- Refining of cane sugar produces a by-product known as blackstrap molasses.
- Cane molasses incorporation into pelleted feed has a positive effect on the physical properties of the pellets

- Molasses is a good partial replacement for the more expensive cereal grains as an energy source.
- Because molasses ferments rapidly, it may also be added in small quantities along with rice bran to trash fish in the production of fish silage

Brewers spent grains

- This material, the extracted malt, is a valuable source of protein and energy which is often thrown away or used as a fertilizer
- Brewers spent grains, or brewery wastes, as they are often termed, are residues from the initial breakdown of starch to fermentable sugars in beer manufacture.
- Fresh brewers grains are fairly rich in protein and digestible carbohydrates

- The material, if mixed with other feedstuffs before feeding, should first be boiled to deactivate enzymes that may otherwise act on carbohydrates to produce alcohol, and then organic acids
- Raw brewery waste is available in considerable quantities in large urban areas of most countries.
- Level up to 50 % in the diet have been successfully fed to tilapia in Africa

Brewers yeast

- It is obtained as a residue after the fermentation process in beer production.
- Yeast is a rich source of B-vitamins (excepting vitamin B12) but low in calcium
- Due to its high cost, it is seldom used at levels beyond 5 % of the total diet.
- This yeast is usually *Saccharomyces* spp.

Grain Distillers By-products

- They are generally of greater value than brewery wastes and more expensive.
- It contains 26-30 % crude protein, 9.2 % fat. 9 % crude fibre.
- Deficient in lysine but supplemented with crystalline *L. lysine*

- Starch Industries: Maize gluten and wheat gluten use the by products from grains to wet milling operation gluten (45-48 % protein)
- Sugar Industries
 - Molasses (less than 3 % protein): 1-9 % level in fish diet due to stickiness. At higher level 25 % and above, has laxative effect
 - Press mud: By product of sugar cane industry during precipitation 25 % level replacing rice bran in traditional diet. 15 % protein and oil (7 %) apart from minerals