

Alternative Protein Sources in Animal Feed

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Introduction

One of the most important as well as expensive nutrients in animal feed is protein, which is required for growth, reproduction, health and improved productivity of livestock and poultry. In order to meet the increasing demand for meat, milk, egg and fish the animal production is expanding globally. Soyabean meal and fish meal has been used as the conventional protein sources for livestock and poultry. To reduce the dependence on limited available conventional protein sources, alternative protein sources come into focus. Alternative protein sources are the non-conventional feed ingredients which are generally used to replace traditional feed ingredients partially or completely. They include insect meal, single cell protein, agro-industrial by-products, algae, leaf protein concentrates etc. They also possess certain beneficial effects, which include decreased production costs, lower environmental impact and improved utilisation of resources etc.

Major alternative protein sources

1. Insect meal

The introduction of insect meals as an alternative protein source has reduced the dependence on the land and water; also lowered the emission of greenhouse gases to a greater extent (Gasco *et al* ,2020). Insects also possess the ability to convert the waste of low value to good quality proteins. Among the insect's Black soldier fly larvae, yellow mealworm and common housefly are considered to be the most important ones. They are rich in essential amino acids like lysine, methionine and threonine having crude protein content of 40-65%; also, they possess healthy fats, which are responsible for optimising the immune functions of livestock and poultry.

2. Single cell protein

Single cell protein (SCP) is the total protein extracted from micro-organisms such as

bacteria, yeast, fungi and algae. The CP content of SCP ranges from 40-80% on dry matter basis. Several studies show that it has a very faster production rate with less use of land and water which is highly essential to meet the increasing demand for animal products (Bratosin *et al.*, 2021)

3. Algae and microalgae

The protein content of algae and microalgae (like spirulina and chlorella) is very high that is about 30-70% on a dry matter basis. They are rich in essential amino acids, omega-3 fatty acids, vitamins and minerals, which is required for proper growth, health and improved production purpose. Microalgae have the ability to grow in uncultivated land at a faster rate reducing the competition with food crops (Saadaoui *et al.*, 2021). When specific seaweed varieties are used in ruminant feed, they reduce the methane emissions to a larger extent and improve the quality of milk.

4. Plant derived protein sources

Some common plant derived protein sources are Cottonseed meal, sunflower meal, canola meal, legume by-products, lupin seeds and pea proteins (Xiao *et al.*, 2023). They have the capacity to reduce the feed conversion ratio along with feed cost. Raw plants are generally fed after thermal processing (heating, fermenting, or extruding) as they possess Anti-nutritional factors which limits the availability of nutrients in animals.

5. Duckweed

On dry matter basis, crude protein content of duckweed is 20-40%. In comparison with other plant proteins, duckweed is considered to be an excellent source of essential amino acids containing lysine and methionine. Other advantages of duckweeds is that it requires wastewater for its growth and it also possesses the ability to double their number by vegetative propagation. They can be added in poultry, swine and ruminant's diet. In the case of poultry it accounts for improvement of egg quality and in ruminants it provides important minerals like phosphorus and potassium along with highly digestible protein (Song *et al.*, 2025).

6. Agro-industrial by-products

Agro-industrial by-products are the residues of feed processing companies. For predominant reduction in waste production the agro-industrial by-products have been used as the alternative protein sources in animal feed (Suriyapha *et al.*, 2022). They also have fluctuating nutritional composition; so, before feeding it to animals they are analysed properly and mixed with synthetic amino acids for preparation of a balanced diet. Circular bioeconomy is the main target of agro-industrial by-products which is achieved by reducing the destruction of wastes in landfills and reducing the methane emissions.

Conclusion

Keeping an eye on the highly growing population and to Maintain a balance between

demand and supply alternative protein sources in animal feed is one of the best approaches. It is also cost-effective as it uses minimal land, water and environment-friendly because of its contribution in lowering the greenhouse gases emission.

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