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Moringa Feeding as An Alternative Protein Source in Livestock Production

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Introduction

One of the major constraints for dairy production in India is the non-availability or fluctuating quantity and quality of the year-round green fodder supply. Farmers feed their animals mostly on crop residues and poor-quality straw/hay that are low in nitrogen, high in lignocellulose and poor in minerals and vitamins that leads to low digestibility and reduced voluntary feed intake. Utilization of fodder trees and shrubs could be a potential strategy for increasing the quality and availability of feeds for resource-limited dairy farmers. In recent years, there has been increase in usage of Moringa leaves as substitutes for traditional protein feeds for monogastric animals (e.g., rabbit, chicken, pig), ruminants (e.g., cattle, buffalo and sheep), and aquatic animals. The global demand for meat products has increased rapidly worldwide in recent years. The FAO reported that the consumption of global meat products increased by 1.2%. The increased consumption of livestock, poultry, and fish products in people's diet threatens to drive production toward the use of more and more conventional crops in animal feeds as additives. To sustain such high consumption, a parallel increase in volume of animal feed production is inevitable. Hence innovations in healthy animal husbandry made by ensuring protein feed stuff supplements as value addition apart to conventional feed.

Plant Characterization

Moringa oleifera is a rapidly growing, Perennial soft wood plant that is mainly distributed in tropical and subtropical zones. Moringa tree is a drought-tolerant, fast-growing, multi-purpose and one of the most useful trees due to its medicinal value, high nutritional properties, high protein biological value & good feeding effect, and therefore described as a ‘miracle tree. Moringa grows in all types of soil, naturally drought resistant crop and grows even during the scarcity period of the fodder. The tree has a capacity to produce high quantities of fresh biomass per unit area and produces dry matter yield from 4.2 to 8.3 tons per hectare with a cutting frequency of 40 days interval. The leaves are highly nutritious with excellent palatability, digestibility and balanced chemical composition of protein and minerals. M.oleifera leaf is

rich in mineral elements such as calcium, iron, potassium, phosphorous and zinc which are key elements for animal growth and development. M.oleifera has higher lysine, leucine, histidine, glutamic acid, valine, isoleucine, alanine, phenylalanine and arginine contents which is significant, than that in other woody plants. Amino acids that cannot be synthesized by animals are called essential amino acids. For the synthesis of a specific protein, the required essential and non-essential amino acids must be present at the site of synthesis according to the requirement of an animal. Otherwise, shortage in an amino acid may limit the use of other amino acids in the diet. The first amino acid to limit protein synthesis is termed as first limiting amino acid. When the insufficient content of this amino acid is resolved, the next amino acid that limits synthesis is the second limiting amino acid. Therefore, the balance between essential and nonessential amino acids in feed formulation should be considered. The comprehensive pattern of essential amino acids in M.oleiferaleaf is modest and accounts for 52.19% of total amino acids. Notably, M.oleiferahas higher lysine content than Broussonetia papynifera and Caragana korshinskii and has almost eight times the lysine content of corn meal.

Nutritive value of Moringa olifera

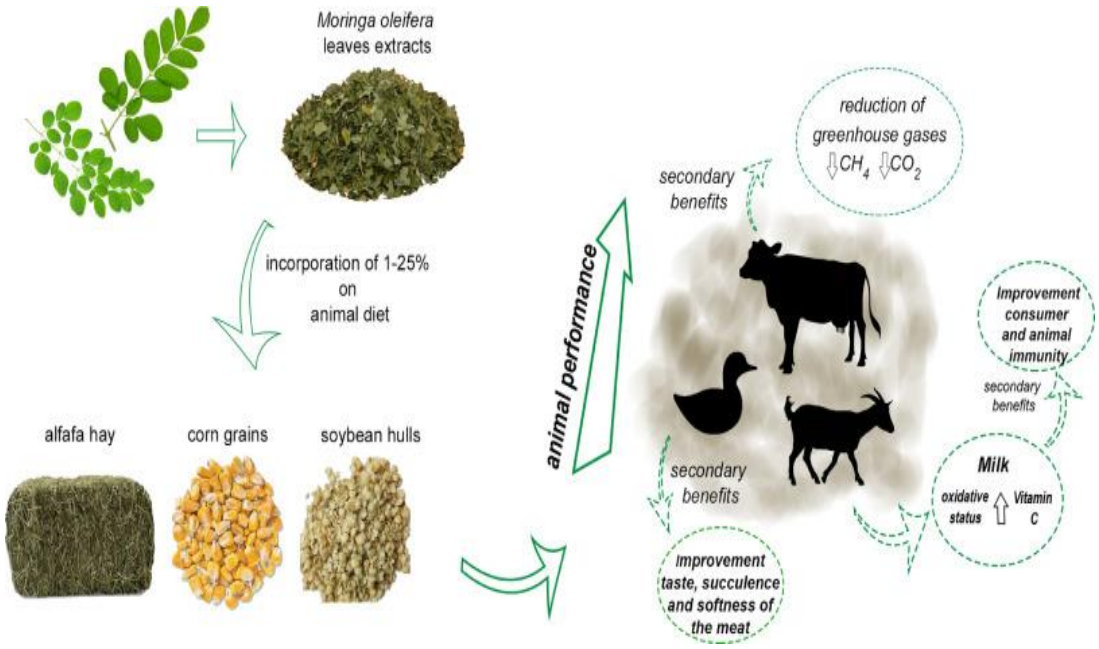
In recent years, M.oleifera has increasingly attracted the attention of researchers in animal husbandry because of its comprehensive nutritional, antioxidative and medicative attributes. M.oleifera contains high amounts of crude protein, vitamin, mineral and fatty acid. Phytochemical analyses showed that M.oleifera contains 16-19 amino acids, including the 10 essential amino acids, namely threonine, tyrosine, methionine, valine, phenylalanine, isoleucine, leucine, histidine, lysine and tryptophan. Aside from promoting animal productivity and favorably influencing lipid composition, the potent antioxidant in M.oleiferaleaf prevents meat products from deterioration. Although the relatively high content of indigestible substance in woody plants can affect the feed intake and digestion rate of livestock, 1 kg of M.oleiferaleaf contains only 12g of tannins, which is lower than that in other woody plants. Moreover the consumption of M.oleifera leaf strengthens neural response, enhances immune functions and improves animal health because of the large amounts of microelements and polyphenol antioxidants.

The inference from studies in the recent past concluded that M. oleifera leaf can be used as an alternative protein source for animal husbandry.

Nutritional benefits in Various species

The leaves of M.oleifera considered as miracle tree species are readily eaten by cattle, sheep, goats, pigs and rabbits. Even though feeding moringa leaves is feasible but the presence of fiber & antinutritional factors limits the usage of moringa leaves to certain limit in poultry, pigs & fish. M.oleifera leaves and leaf extracts have been used as feed additives in animal diets to improve meat quality owing to the leaves abundant secondary metabolites. The high amount of β-carotene precursor for Vitamin-A in M.oleifera promotes growth and reproduction and maintains various physiological functions. Moringa oleifera is

considered as a promising protein source for inclusion in fish diets at low levels. It is rich in protein and has been tested in various fish species as a potential replacement for fish meal. However, feeding trials resulted that only limited amounts of moringa leaf meal can be safely used in fish diets, which is probably due to the presence of phenolics, saponins, phytic acid and other metabolites with antinutritional effects in fish. Chickens fed on moringa leaves and seeds reported with improved egg production. The inclusion of Moringa oleifera leaves meal up to 30% in the diet of growing traditional chickens had no negative impact on live body weight, average daily weight gain, feed conversion ratio, carcass and organs characteristics, health and mortality rate in birds compared to their controls. Studies on growing lambs fed on low-quality hay reported that Moringa leaves totally replacing cottonseed cake by increased hay intake, diet DM digestibility and daily weight gain. A study conducted in growing kids indicated that Moringa leaves used up to 50% as sole supplement into diets based on low quality forage increased daily weight gain and diet digestibility. Feeding moringa leaves had variable effects on DM intake and milk yield but with no definitive change in milk composition in dairy cattle. When it offered as sole forage (fresh or ensiled) plus molasses gave the same results as low nutritive forage supplemented with concentrate.



Cattle

Feeding moringa leaves and green stems increase milk production by 43-63%. It also increases daily weight gain in cattle by 32%. It is even rich source of vitamins (mainly A &C) and minerals. Addition of moringa leaf extract to feed enhance reproductive performance by controlling conditions like Anestrus, repeat breeding considered as primary measure of success of livestock production system. The anti-oxidant effect of moringa maintains the udder health by preventing the animal prone to mastitis. Due to increased

lipid mobilization during transition period to combat the negative energy balance, the animals are more susceptible to oxidative stress, and inflammatory and immune dysfunction. These physiological alterations increase the risk of occurrence of metabolic and inflammatory diseases in transition animals. The antioxidants present in the circulatory systems plays a crucial role in maintaining the balance between damage due to oxidative stress and repairing of oxidative damage.

Poultry

The high nutritional factor, including high protein content, the abundance of micronutrients and various phytochemicals, has contributed to the rapid use of *M. oleifera* in the poultry diet. Moringa oleifera leaves incorporated into maize meal poultry feed led to better growth performance of the chicks and a significant increase in the serum level of biochemical minerals compared to the maize meal feed alone. Feeding of Moringa leaves to poultry aids as growth promoter and increases in the body weight gain, immune booster and assists the antimicrobial property & the antioxidant effect prevents the birds from oxidative damage.

Small ruminants

Feeding moringa as a supplementary feed to small ruminant's aids in weight gain in lams, early maturity with high lambing & kidding rate. This also aids in Maintaining oxidative stability of meat & shelf life.