



Phytochemicals As Feed Additives in Dairy Cattle

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Introduction

The ruminant feed pyramid as illustrated by Lundquist (1995) provides the basis for formulating ration for dairy cattle. High quality forages and grains form the basis of all diets and support good milk production but in order to ensure higher milk production, fats, rumen undegradable protein and other feed additives are required.

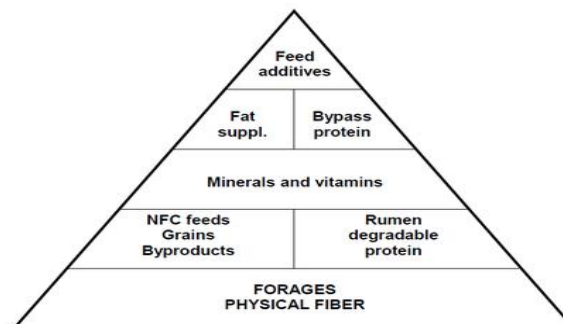


Figure 1: Ruminant Feed pyramid (Lundquist, R. 1995)

Feed additives are added to animal feeds to achieve an effect on the feed itself, on the animals, on food products obtained from the animals consuming the feed additive, or on the environment. Among the feed additives, phytochemicals are gaining popularity because of their ability to stimulate immune system, enhance antioxidant activity provide antimicrobial effect and better feed conversion efficiencies. These compounds, thus, have the potential to promote the growth of producing animals.

Phytochemicals

The word 'phytochemical' was originated from a Greek word *phyto*, which means plant. Phytochemicals, also known as phytobiotics or phytogetic compounds, are bioactive secondary metabolites secreted by plants as a defense mechanism in response to various predators or fungi, bacteria and virus infections. They are also known to impart distinct colour, aroma, and flavour to the plant. Their

widespread presence in the feed ingredients and apparent low toxicity suggest that phytochemicals have the potential to impact health and disease risk in animals. Phytochemical feed additives are an extremely large group of compounds with huge variation in chemical structure and biological activity.

Mode of action of phytochemicals to increase production

Inclusion of phytochemicals in diets stabilizes the gut microbiota and reduces toxic metabolites in the gut, thus improving the rumen health. They also improve overall health by reducing oxidative stress and increasing antioxidant activity in various tissues. Furthermore, they have immunomodulatory effects. Thus, by reducing the overall stress on animals, animal is able to efficiently use the energy and thus divert it towards production.

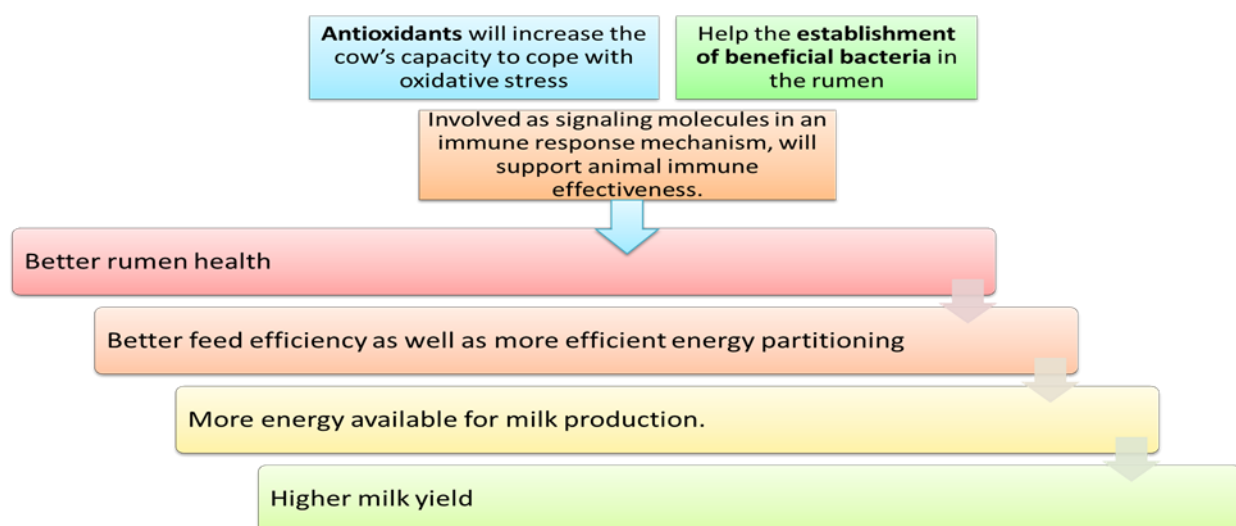


Figure 2: Mode of action of phytochemicals as feed additive

The different biological activities of phytochemicals can be explained by four principal mechanisms that have been observed by various researchers in the studied animals:

1) Improvement of feed status and animal feed intake: Phytochemical additives may enhance the flavor and palatability of feed, hence improving the feed intake of the animal as well as enhancing the growth and production performance.

2) Modulation of ruminal fermentation: Phytochemicals exert anti-bacterial effects and changes in rumen microbiota by following ways:

- inhibition of cell wall synthesis
- disruption of cell wall structure
- inhibition of nucleic acid synthesis
- inhibition of protein synthesis and inhibition of a unique bacterial metabolic pathway

3) Improvement of nutrient digestion and absorption: These biological activities related to the animal's digestive tract are primarily attributed to:



- increased digestive secretions
- decreased bacterial counts and pathogen loads via an antibacterial effect in the intestinal lumen
- improved gut morphology due to developed antioxidant and anti-inflammatory activities in the intestinal lumen,
- prebiotic activity
- reduced fermentation products, such as nitrogen compound waste

4) Source of direct and indirect anabolic activity on target tissues

There are structural similarities between some phytochemicals (e.g., hydroxycinnamic acid derivatives of the amino acid phenylalanine) and catecholamines, which are natural animal hormones. These hormones interact with β -adrenergic receptor agonists to change animal metabolism, mainly by increasing protein synthesis and lipolysis and by decreasing lipogenesis.

Phytochemical additives also have immunostimulatory and antioxidant effects; thus, these effects can result in favorable conditions for animal health, and they can focus on target tissues, such as muscle and the intestinal lumen by promoting their growth and improving their antioxidant status.

Conclusion

To increase the milk production in high producing dairy cattle, we need to include feed additives in the ration of animals. Phytochemicals have recently gained importance because of their diverse range of effects on animal health. This reduces the undue stress on the animal and helps in efficient energy partitioning and the animal is able to utilize more energy for the growth and production purposes.

References

Lundquist, R. 1995. The feed pyramids. Dairy Today (Nov./Dec.), p. 26.