Environmental implications of using β-mannanase in broiler feeding programs

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Introduction and Objectives

Feeding is an important source of environmental impacts associated with poultry production systems. Thus, improving feeding practices may mitigate the environmental footprint of broiler production. The present study was therefore undertaken to assess the environmental implications of using β-mannanase in broiler feeding programs.

Results

The impact of climate change was estimated with the CML-IA baseline method. Producing feeds (1 kg at feed mill gate) in Southern Brazil using grain cultivated in the same region led to the emission of 816 to 910 g of CO2-eq (climate change) and 4.62 to 4.97 g of PO4-eq (eutrophication), depending on the broiler phase (Table 1). A formulation procedure that considered the energy saved by β-mannanase mitigated the impact of climate change by 5.0 to 5.6% and eutrophication by 1.1% (Fig.2).

Methods

The functional unit considered was 1 kg of feed produced at a feed mill gate located in Concórdia, Santa Catarina, Brazil; simulated through a cradle-to-feed mill gate scope (Fig.1). Environmental impacts were evaluated according to life-cycle assessment standards using four interrelated steps: goal and scope definition, life cycle inventory analysis, life cycle impact assessment, and interpretation of the results. The major stages considered in the model were the production of feed ingredients from plant sources, the production of other feed ingredients, drying, processing, storage, and transportation. The simulation considered a scenario in which only grain from the Southern region was used to produce the following feeds: (i) without the enzyme based on the nutritional requirements of broilers or (ii) with a low-energy diet supplemented with β-mannanase (reduction of 45 kcal of metabolizable energy/kg of feed). Inputs and outputs were defined for each stage of the life cycle assessment and organized in a model using the SimaPro software (v. 8.0.3.14).

Figure 1. Flowchart of feeding programs being assessed through life-cycle assessment standards. Crop inputs, crop production, β-mannanase production, production of the other feed ingredients, drying, processing, storage, transportation, and feed production were the main processes considered, with system boundaries including all sub-processes.

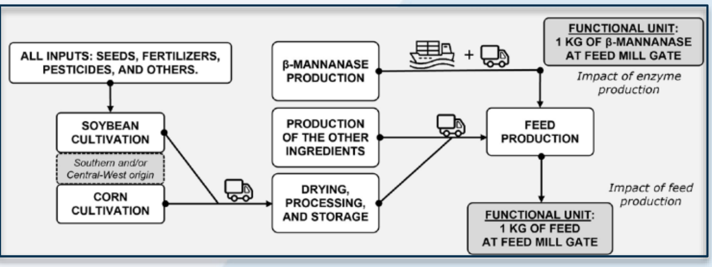

Table 1. Potential environmental impacts of control feeds (1 kg at feed mill gate, formulated without β-mannanase).

	Starter		Growing		Finishing
	I	II	I	II	
Climate change, g CO_2-eq	816	877	910	857	848
Eutrophication, g PO_4-eq	4.94	4.97	4.90	4.71	4.62
Acidification, g SO_2-eq	5.96	6.13	6.56	7.17	7.50

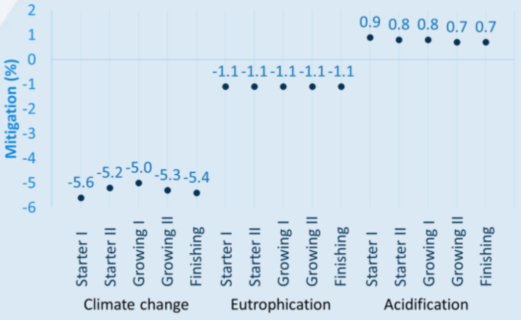

Figure 2. Potential environmental impact mitigation associated with the production of broiler feeds, considering energy savings from an energy matrix of 45 kcal of ME/kg of feed by β-mannanase supplementation.

Conclusions

Due to their high environmental impacts, feeding practices may be considered a prime target when developing mitigation strategies for the broiler production chain. In this context, the use of exogenous enzymes like β-mannanase may be an effective approach for improving the environmental sustainability of broiler production.

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