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Environmental advantages of phytase over inorganic phosphate in poultry feed

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Introduction

Indian poultry production is a centuries old industry which started as a backyard activity, and it is only in the last three to four decades it has got transformed into a well organized, scientifically and technologically driven industry. India is going through a live stock revolution with a growing poultry population (see Table 1) and a growing demand for animal feed.

Table 1: Poultry population in India (In million). Ministry of agriculture (2010).

Year	1997	2003	2007
Poultry population	347.6	489	571

With the growing demand for the poultry products, it is necessary for the producers to meet the demand with a healthy chicken.

Therefore it is necessary to have a proper feed with a standard and specified nutrient rich diet balance. Phosphorous is an essential nutrient for poultry chickens for their bodily functions. Phosphate is naturally found in many feed ingredients but only parts of it are available to poultry and other monogastric animals because the phosphorus is bound in phytate, see Table 2

High quality inorganic phosphates such as mono calcium phosphate (MCP) and di-calcium-phosphate (DCP) offer the combination of a consistently high total phosphorus content and excellent digestibility and are therefore widely used as supplemental phosphorus.

Table 2: Amounts and estimated availability of P in selected feed materials for poultry feed, International Plant Nutrition Institute (1999)

	Corn	Barley	Wheat	Soya bean meal	De -Hulled Canola meal
P content (%)	0.28	0.36	0.37	0.65	1.01
P availability (%)	16	37	46	38	30

Most inorganic phosphates used for this purpose are derived from natural rock phosphates which are limited resources. Phosphate is essential to plant production and phosphate rock needs to be preserved to ensure high output of agriculture in the future.

Biologically produced industrial enzymes like RONOZYME®NP phytase degrades phytate in the feed and in this way makes phosphate available to monogastric animals like poultry

Novozymes is a major enzyme manufacturer and we and our alliance partner DSM has a number of different phytase products on the shelf under the brand name RONOZYME®.

Novozymes and DSM are partnered and engaged in finding sustainable solutions for the future and Novozymes recently conducted an environmental comparison of phytase enzyme in poultry feed over inorganic phosphorous.

The study refers to a European scenario, but it is also relevant for the Indian scenario as we increasingly produce poultry with the same industrialized techniques.

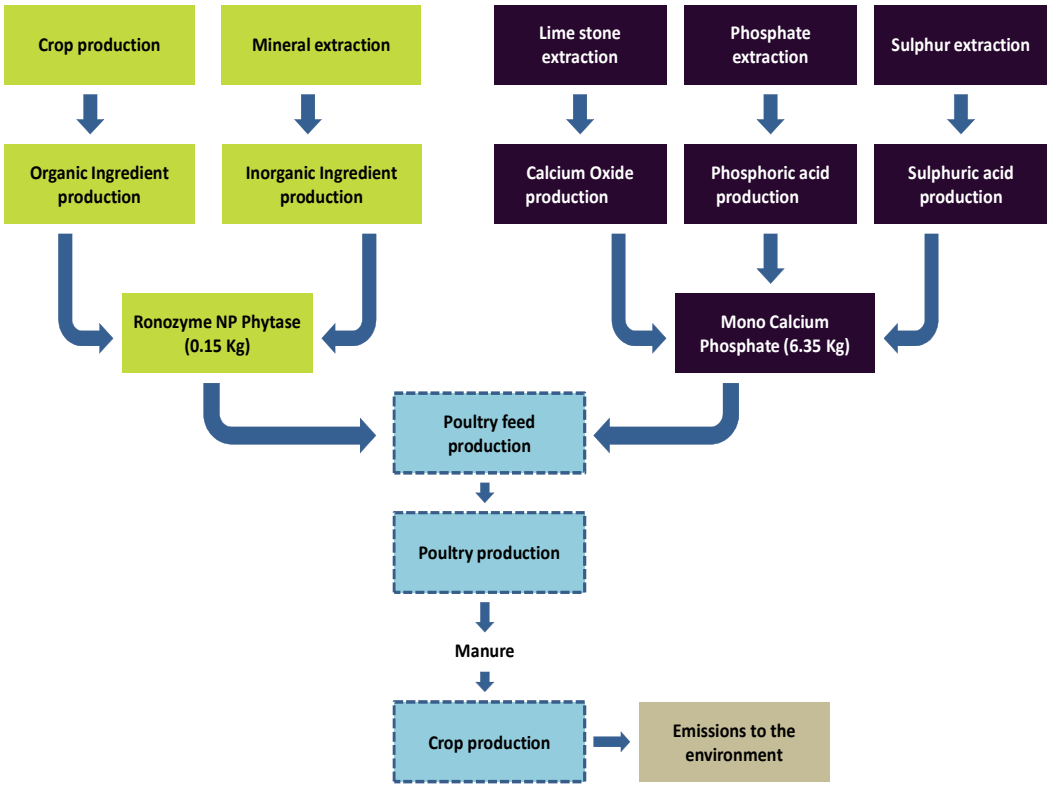

Figure 1: Main system boundaries of the study. Process indicated to the left (green) are induced process and process to the right (purple) are displaced when RONOZYME NP phytase displaces inorganic phosphorous supplementation in poultry feed. Poultry feed production; poultry production and crop production (marked with dotted boxes) are not changed when phytase displaces MCP

Methodology

Life cycle assessment has been used to estimate the total environmental impact in terms of energy consumption, global warming potential and algal bloom etc. of phosphorous from the two different sources (phytase and MCP). This tool is used to calculate environmental impact of two different sources from raw material extraction up to the disposal of the product (in the manure form) on the basis of weight of phytase and MCP respectively. The study refer to a specific composition of feed where 0.15 Kg phytase replaces 6.35 kg MCP in one tonne of poultry feed. Feed composition is determined by modeling in Agri Soft WinOpti. Environmental modeling is conducted in SimaPro software. The concept of the study is described in more detail - by Nielsen and Wenzel (2006) who conducted a similar study for pig-production.

Scope of the assessment

Figure 1 above shows the processes which are included in the assessment. Processes to the left show production of phytase enzyme whereas process to the right show inorganic phosphorus production processes. 0.15 kg phytase replaces 6.35 kg inorganic phosphate. It is assumed in the model that 5% of the phosphate which is put on farmland with manure is leaching into the environment and contribute to algae bloom in lakes and rivers

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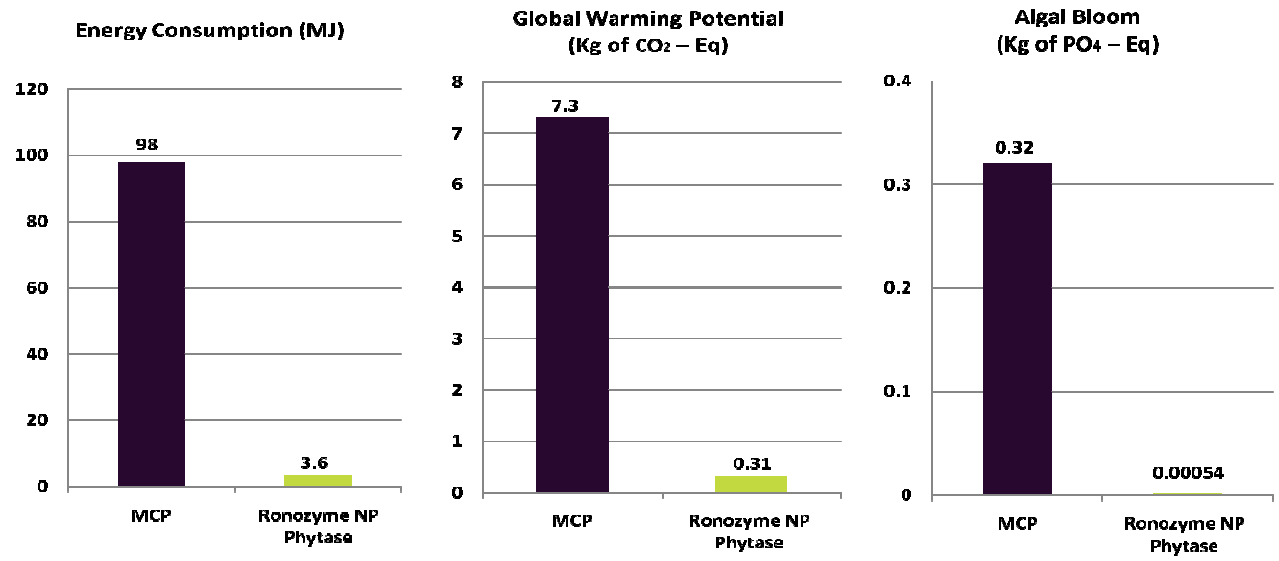

Figure 2: Environmental impact indicators of MCP and RONOZYME NP phytase (all data are per ton feed).

Results

Figure 2 shows energy consumed to produce RONOZYME NP phytase is about 3.6 MJ per tonne of poultry feed over MCP with a consumption of 98 MJ per tonne of poultry of feed. Contributions to global warming potential follow same pattern because of the CO_2 emissions from energy conversion and production process of RONOZYME® NP phytase is less over MCP energy conversion and production process.

The reduced amount of phosphorus added to the feed from phytase as a replacement to MCP leads to reduced emission of phosphorus with the manure and finally reduced emission of phosphorus to the environment as also indicated in the Figure 2. Phosphorus is undesirable in the environment because it leaches into lakes and rivers causing algal bloom and finally resulting into death of fish

Conclusion

Phytase can make phosphorus naturally occurring in feed available to chicken and hereby reduce the need for Inorganic Phosphorus supplementation to the animals' diet

Using phytase as alternative to inorganic phosphorus is an advantage to the farmer because it reduces production costs and an advantage to the environment because,

- It saves scarce resources of phosphate rock.
- It reduces contribution to algae bloom by reducing the amount of phosphorus which is emitted to lakes and rivers.
- It reduces impact on the climate as enzyme production uses less energy than inorganic phosphorus production.

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