Managing phosphorus cycling in agriculture

Feeding management as a tool to reduce phosphate excretion in animal husbandry

Introduction

Due to more restrictive application standards for phosphate and nitrogen on agricultural land, less manure can be applied in the coming years. Therefore, reduction of phosphate excretion will be necessary to prevent shrinkage of animal husbandry. Changes in feeding management will be helpful to reduce it. Phosphorus (P) is an essential mineral that is involved in bone formation and energy metabolism. Therefore, these changes should be applied in a responsible manner. To prevent P-deficiency in cattle, pigs and poultry, we have to determine 1) the P-requirements of each animal category, and 2) the P-digestibility of dietary ingredients.

The aim of this study was to determine the contribution of nutrition to phosphate excretion in animal husbandry.

Methods

- Review of P-requirements per animal category;
- Determination of the current variation in phosphate excretion of Dutch dairy cattle and pig farms;
- Definition of P-low feeding strategies;
- Calculation of the consequences of these strategies for diet composition, feed price and phosphate excretion.

Results 2009-2010

Dairy cattle

P-content of an average Dutch ration for dairy cattle is 4.2 g P/kg DM. This is much higher than the requirement of 2.8 g P/kg (2.0 g/kg DM for dry cattle and 3.5 g/kg DM for lactating cattle). Therefore, phosphate excretion of cattle can be significantly reduced by feeding them in accordance with their requirements. Reduction of the P-content of a dairy ration can be applied by:

- a shift from P-high to P-low ingredients (e.g. from grass silage to maize silage);
- reducing the phosphate application to home grown roughages;
- purchasing P-low roughages and concentrates.

No indications in literature were found that feeding dairy cows according to their requirements will cause any problems. From a review of recent literature (1999 – 2010) it can be concluded that this will not negatively affect performance, health status or fertility. Dairy cattle are even able to deal with negative P-balances during short periods, because they are able to release P from their bones.

Pigs/Poultry

Fast growing pigs or lactating sows have higher requirements for digestible P compared to pigs that have a physiological status close to maintenance (e.g. gestating pigs). Similarly, available P-requirements are higher in young very fast growing broilers, compared to adult laying hens. Advised digestible P-contents of

pigs range from 1.5 g/kg in gestating sows to 3.4 g/kg in young piglets. Advised available P-contents of poultry range from 2.6 g/kg in adult laying hens to 3.9 g/kg in young broilers.

In monogastrics, P-digestibility of ingredients vary largely (from 15% in sunflower seed extracted to 77% in fish meal). Because pigs and poultry are lacking phytase, they are able to digest vegetable P-sources for only one third of the total P-content. Addition of microbial phytase to the diet, however, allows the animals to digest the bad digestible phytate-P as well.

Possible feeding strategies to reduce phosphate excretion are:
1) applying phase feeding;
2) The use of (higher inclusion levels of) microbial phytase
3) The selection of ingredients with a low level of indigestible P.

Phase feeding adjusts P-supplementation to P-requirements of the animal. Phase feeding is mainly interesting for gestating sows, growing-finishing pigs and broilers. Phytase addition to the diet results in an increased P-digestibility. As a consequence, the use of feed phosphate sources can be reduced. Selection for ingredients with a high digestible P content will also result in a reduced use of feed phosphate sources. The effect of these feeding strategies on phosphate excretion in breeding sows is summarized in Table 1.

Table 1 Effect of different feeding strategies on phosphate excretion in breeding sows

Breeding sow and piglet to 25 kg		Control	Phase feeding	More phytase	Increased P digest.
Relative P excretion	%	100	95	90	75

Reduction of the total P-content of the diet, thereby maintaining digestible P-content, seems to have only limited effects on feed price. No indications in literature were found that the use of P-low diets negatively affect feed consumption and feed efficiency. Nevertheless, there are still farmers that are not convinced that the use of P-low diets will not reduce high performance levels of their flocks.

Conclusions and recommendation

Applying P-low feeding strategies might result in considerable reductions of phosphate excretion in animal husbandry. A reduction of 20% is realizable, without negative effects on animal performance and health. Reductions will only have a limited effect on feeding costs. Depending on market prices, species, and reduction levels, increase in feeding costs do not exceed 4%. This may result in a reduction of the Dutch phosphate burden of about 9 million kg.

Ration calculations for dairy cattle should take P-requirements into account. It should be taken into account that the concentration of rumen resistant protein should not be affected, to prevent occasional loss of phytate-P. Moreover, agalaxy should be prevented, because it results in increased P-excretion by saliva and urine.

As far as known, there are no present incentives for pig- and poultry farmers to apply P-low feeding strategies. Therefore, demonstration projects should be started up to convince farmers and to contribute to the development of the applied knowledge.

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