NITROGEN AND PHOSPHORUS EXCRETION IN RABBITS: A CALCULATION BASIS FOR COMMERCIAL FARMS

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ABSTRACT

In several areas with a high density of animal production, manure is no longer exclusively considered as a fertiliser. In order to limit the production or a more environmental friendly use, efforts are done to reduce the mineral excretion. In such a context, both from governmental side as for the producer a reliable calculation of the on farm production is useful. Based on the input (feed) output (produced rabbits, dead rabbits) balance, the nitrogen and phosphorus farm excretion is calculated for different production systems. For a closed farm (breeding + fattening) the most convenient expression of mineral excretion is per female on average present in the farm. The excretion amounts 7.56 kg N and 4.72 kg P_2O_5 per doe/year in a commercial rabbit farm based on an average production/doe of 45 fatteners of 2.5 kg. In an exclusively fattening unit (between 0.8 and 2.5 kg weight and a feed conversion ratio of 3.25), the excretion amounts 88 g N and 60 g P_2O_5, per produced rabbit.

Key words: rabbits, N and P, excretion, calculation.

INTRODUCTION

Mineral pollution of water and soils originating from animal production has become a major problem in several European countries. Manure is no longer considered as a fertiliser, but as a polluter of the environment. Agricultural ammonia production is partly responsible for the acidification problems (acid rains) and heavy metals (Fe, Mn, Pb, etc) are linked with decreasing quality of surface and drinking water. Besides EC-directives (e.g. N-directive 91-676 CEE), in several countries or areas having a high density of animal production measures are taken to control or to reduce the excretion of mainly N and P. For example in The Netherlands and Belgian (Flemisch region) farmers have a maximum quota of N and P that they are allowed to produce on their farm. Above this quantity, farmers have to pay high taxes. Moreover, the production data are used for a responsible spreading of the excreta on agricultural land.

In this view, both from government side, as for the farmers a scientific based calculation of the excretion is a tool for a more optimal use of the excreta. Till now, only partly or divergent data are available for rabbits (VAN EERDT and GROOT-SEVERT, 1994; MAERTENS, 1999; CORPEN, 2000). Part of the differences can be explained by the way of expressing (e.g. per fattening rabbit or per doe) or by the production type or level (closed farm or just fattening).

The present paper intends to propose a scientific based calculation of the N and P excretion for different rabbit production systems and to be a tool for the prediction of the real on-farm excretion.

MATERIAL AND METHODS

The calculations are based on the principle (hypothesis) that the excretion is the difference between the input and the retention in the body. The balance for a mineral X during a certain period (commonly calculated on a yearly basis) can than generally be expressed as:

Dietary level of X (g/kg) x feed consumption (kg) – content of X in the body (g/kg) x weight of the body (kg) = excretion of X (kg).

The calculation will be performed for the 3 different types of rabbit production systems: closed farms (reproduction + fattening unit), only breeding (weanlings are sold) and only fattening. The different data necessary to calculate the excretion will be presented for these 3 types of rabbit units. For a closed farm, the excretion per average doe will be calculated including those of the fatteners, young reproduction stock and males (if any), because production data are also expressed per average doe.

Dietary levels

The N and P of the diet can quite easily be analysed. However, differences occur according to the feed batch even with the same raw material composition. For the calculations we have taken an average crude protein level of 180 g/kg for breeding does and 160 g/kg for fatteners based on the recommendations of DE BLAS and WISEMAN (1998). This means 28.8 g/kg and 25.6 g/kg N, respectively. Because the fatteners consume 2/3 of the feed in a closed farm, an average CP level of 167 g/kg or 26.7 g/kg N is used.

The phosphorus levels in rabbit diets are in the range of 4.5-7.5 g/kg for breeding does and 3.5-7.0 for fattening rabbits (MATEOS and DE BLAS, 1998). Based on these data and on calculated data of commercial diets, the following average dietary levels will be used for the calculations: 6.60 and 6.40 g/kg for does and fatteners, respectively and 6.45 g/kg as average for a closed farm.

Feed consumption

The feed consumption depends on a lot of factors, being the most important the age of the rabbits, the category (reproducing – fattening), the market weight, the reproduction level (number of young produced/doe), the strain and the energy content. However, on

farm level all these factors are included in the global feed conversion ratio (FCR). Moreover, in the global FCR of the farm also the effect of mortality is included. For the calculations we have used the data of MAERTENS and VILLAMIDE (1998) because they are still in line with published French field conditions (GUERDER, 2002).

N content of rabbits

In the literature, data are not available for the whole body composition in contrast with the empty body (EB) composition. Therefore an estimate will be proposed based on the EB composition and considering that the average N content in the gut is comparable with the dietary composition.

According to literature data (DEHALLE, 1981; GARCIA *et al*., 1993; MAERTENS *et al*., 1998) the N-content in the EB of slaughter rabbits (± 2.5 kg LW) is on average 32.6 g/kg. Based on the work of FRAGA *et al*. (1983); SZENDRÖ *et al.* (1998) and XICCATO *et al.* (2003), the N content increased with increasing live weight (LW) or age. This relationship is expressed in the following equation:
N (g/kg): 28.3 + 0.93 x LW (kg) (SZENDRÖ *et al.,* 1998),
or for each 0.1 kg difference in LW the N-content changes with 0.093 g/kg.

The difference between LW (no fasting) and EB weight is for fatteners around 14% (MAERTENS *et al.,* 1998; XICCATO *et al.,* 2003). If we assume that the average N-content in the gut is the same as in the diet (28.4 g/kg DM) with an average DM content of 20% (LEBAS *et al.*, 1997), than the N-content of a standard rabbit at slaughter (2.5 kg LW) is:
32.6 x 0.86 + 0.14 (28.4 x 0.20) = 28.8 g N/kg LW.

If the average slaughter weight differs from this standard weight (2.5 kg), per 0.1-kg difference a correction of 0.09 g N/kg should be used. The N-content of the EB of does is quite in the same range as fatteners (ROMMERS *et al*., 2001; XICCATO *et al*., 2004). But because the difference between EB and LW is around 10% for does, the N-content is estimated as 30.0 g N/kg LW.

P content of rabbits

There are very few data concerning the P-content of rabbits. In empty bodies, FERREIRA *et al*. (1996) determined 5.14 g phosphorus in rabbits of 2.4 kg. If we use the same recalculation to LW as proposed for the N-content, than the P-content of a standard rabbit at slaughter (2.5 kg) is:
5.14 x 0.86 + 0.14 (6.6 x 0.20) = 4.61 g P/kg LW.

VAN EERDT and GROOT-SEVERT (1994) used a body content of 6 g/kg LW in their calculations. However, the values of Ferreira *et al.* (1996) were confirmed in our slaughter rabbits of 2.5 kg LW. The average content was 5.01 ± 0.36 g/kg (MAERTENS, not published). Therefore for the calculation, an average P-content of 5.0g P/kg LW will be used. Because no distinguished data are available for does and fatteners, a similar P-content will be assumed.

CALCULATION OF THE N AND P PRODUCTION

1. For a closed farm

The input in a closed farm is under normal production circumstances limited to the feed consumption. Minerals leave the farm however, as i) the produced fatteners but also ii) sold non-productive females and iii) removal of dead rabbits.

A production level of 45 fattening rabbits produced (sold) with an average weight of 2.5 kg (or 112.5 kg/average doe) and a farm feed conversion ratio of 3.7 (MAERTENS and VILLAMIDE, 1998) will be used as example for the calculation. The replacement level in a commercial farm is on average 120% and taking into account that 2/3 of them are sold, this means that 0.8 x 4.0kg = 3.2 kg is sold as old females/doe. The average mortality rate of fatteners used in our calculation example is 10%. However they do not have yet slaughter weight when they die. Therefore in our example they are counted only as 50% of the slaughter weight: 0.10 of 112.5 x 0.50 = 5.625 kg. The dead females are estimated as 1/3 x 120 x 4.0 or 1.6 kg or in total 7.23 kg rabbit is carried out/female/year due to mortality. Based on the input and output data and taking the production data of this "average" farm the balance can be drawn (Table 1).

Table 1: Calculation of the N and P excretion in a closed farm (kg/doe/year).

Input	(kg)	N content (g/kg)	N (kg)	P content (g/kg)	P (kg)
Feed:	416.25	26.7	11.11	6.45	2.68
Carried out (kg)					
Slaughter rabbits:	112.5	28.8	-3.24	5.0	-0.56
Old rabbits:	3.2	30.0	-0.10	5.0	-0.02
Dead rabbits:	7.23	28.8	-0.21	5.0	-0.04
Excretion/doe/year			7.56		2.06 or 4.72kg P_2O_5

2. For an exclusively fattening unit

As an example, the following data will be used for the calculation: weaning weight 800 g, slaughter weight 2.5 kg, mortality 8% and a feed conversion ratio of 3.25. This means that 5.53 kg feed is consumed/rabbit (Table 2). A second origin of mineral import in a fattening farm is through the bought weaned rabbits. Their N content is corrected according to their reduced weight. Dead rabbits are assumed to have on average 50% of their slaughter weight or they are counted as 2.5kg x 0.5 x 0.08= 0.1kg/intial rabbit with a N-content of 27.8 g/kg.

3. For an exclusively breeding unit

In such a rabbitry, the weanlings are sold between 4 and 5 weeks with an average weight of 800 g. As production level of the does, the same data will be used as for the closed rabbitry: 45 produced fatteners/doe/year increased with the assumed mortality of 10%. There are different replacement methods for the reproduction stock, e.g. one day old kits, young females or a small group of grand parent stock. Accordingly to the method applied, differences of the maternity global FCR will occur. However, for the calculation we will not make distinction because i) the differences in FCR due to the

replacement method are limited ii) we do not have data to make a reliable distinction. In our example (Table 3), a global FCR of 3.9 will be used although even at a fixed production level, a lot of factors (e.g. diet, mortality, strain,…) have an important positive or negative impact.

The feed consumption expressed per female/year can be deduced from the sum of produced weanlings (0.8 kg x 50 = 40 kg) and sold females (3.6 kg, see closed farm calculation) and the FCR, being 43.6 kg x 3.9 = 170.04 kg.

The output of minerals in the carcasses of the dead rabbits is mainly of the females and can be estimated as 1.6 kg/female (see closed farm). Mortality of young is mainly in early stage and around 20% (GUERDER, 2002). An average weight of these carcasses will not exceed 0.25 kg or their total weight is estimated as 2.5 kg/female/year.

Table 2: Calculation of the N and P excretion in a fattening unit (kg/rabbit).

Input	(kg)	N content (g/kg)	N (kg)	P content (g/kg)	P (kg)
Feed:	5.525	25.6	0.141	6.40	0.0354
Weaned rabbits	0.8	27.3	0.022	5.0	0.0040
Carried out (kg)					
Slaughter rabbits	2.5	28.8	-0.072	5.0	-0.0125
Dead rabbits:	0.1	27.7	-0.003	5.0	-0.0005
Excretion/fattener/year			0.088		0.0264 or 0.060 kg P_2O_5

Table 3: Calculation of the N and P excretion in an exclusively breeding unit (kg/doe/year).

Input	(kg)	N content (g/kg)	N (kg)	P content (g/kg)	P (kg)
Feed:	170	28.8	4.90	6.60	1.12
Carried out (kg)					
Weaned rabbits:	40	27.3	-1.09	5.0	-0.20
Old rabbits:	3.2	30.0	-0.10	5.0	-0.02
Dead rabbits:	4.1	28.1	-0.12	5.0	-0.02
Excretion (kg/doe/year)			3.59		0.88 or 2.02 kg P_2O_5

DISCUSSION

Commercial rabbitries are preponderating both breeding as fattening units. Therefore in our opinion, the most convenient expression of mineral excretion is per female on average present in the farm. This figure is well known and easily controlled. It avoids complicated calculations and moreover the excretion of all rabbits present in such farm

(young reproduction stock, females, young before weaning, fatteners and eventually males) are considered.

The average excretion per doe calculated (Table 1) is somewhat lower than the values of V. EERDT and GROOT-SEVERT (1994), 8.7 and 4.85 kg for N and P_2O_5, respectively. The explanation can be found in the production level (-7%) and FCR (+5%) used for their calculation. Besides the different data used for the calculation, the absence of the correction for dead rabbits explains the difference with our earlier mentioned values of 8.21 kg N and 4.77 kg P_2O_5 (MAERTENS, 1999). On the other hand, the data proposed by the French committee CORPEN (2000) underestimate highly the N-excretion. For a quite comparable production level (45.8 rabbits/doe/year and a FCR of 3.83), the N-excretion proposed is only 3.05 kg while the P_2O_5 is much nearer to our calculated value (4.19 and 4.72 kg, respectively). Moreover, a higher phosphorus excretion than N excretion is unrealistic considering that the dietary P content is at least 4 times lower than the dietary N content.

The above calculated excretion data are still estimates based on average data. Each farm is different according to the own records. The calculation of the on farm excretion can be improved using chemical analyses of the feed and when a correct inventory is done of the feed quantities consumed and the delivered kg of rabbits and carcasses.

Finally, the knowledge of the excretion data and the main factors of variance can be a stimulant to use low protein and phosphorus diets adapted to the requirements of the different categories of rabbits. In this way the excretion can be reduced and by consequence also the environmental pollution in areas with an excess of manure.

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