EFFECT OF THE MONOPROPYLENE GLYCOL ADDITION IN DRINKING WATER AT DIFFERENT PERIODS DURING MATERNITY PERIOD ON THE PERFORMANCE OF RABBIT DOES AND KITS

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ABSTRACT

Monopropylene glycol (MPG), a complementary feed and precursor of glucose for the treatment and prevention of subclinical acetonemia in cattle, has been tested in a rabbit farm by addition in drinking water at different times during parturition period. Three groups of does received 0,4% of MPG in water either during four days before birth B (B-4 days to B, BB group), or double distribution (B-4 to B) and around the lactation peak (B+14d to B+18d, LP group), or without MPG (C group). Mortalities of does and kits were unaffected by the addition of MPG. However, the addition of MPG only before parturition had a positive effect on growths and weights of rabbits from 21 to 25 days old.

Key words: Propylene glycol, *Propane-1,2-diol*, Pre-parturition, Pre-weaning, Nutritional water product.

INTRODUCTION

During the first three weeks of gestation, does increase their feed consumption to support the fetal growth. During this period, energy balance is positive (Gidenne, 2015) and body reserves increase. Does which are concurrently pregnant and lactating need higher digestible requirements (Partridge *et al.*, 1986). At this period, despite a higher consumption, they are frequently in deficit energy balance generally linked to a fertility reduction (Fortun-Lamothe, 2006), a dysregulation of the immune system, and a lower prolificacy performance (Parigi-Bini et Xiccatto, 1993). Therefore, it is necessary to support energy intake of does during this period, especially at the peak of lactation (around 17 days after birth).

Monopropylene glycol (MPG), is a widely used product with diverse applications in animal production. This raw material is colorless, odorless, no corrosive, slightly tasting sugar and water soluble. It is used, as a glucose precursor, for dairy cows at the beginning of lactation to limit the decrease of body weight (Liu *et al.*, 2009). After ingestion, it is absorbed by rumen (Fournet, 2012), or converted in glucose or partially metabolized to propionic acid (C3) via ruminal bacterial fermentations (Studer *et al.*, 1993) reducing ketosis. Rabbits, according analogies with ruminants and monogastrics (Philippe, 1981), can store and metabolize glucose. Provided MPG can be metabolized by the rabbit and no metabolized overage is eliminated in urine (INRS, 2010).

There is no scientific rabbit publication on the period of MPG administration. Some breeders are using MPG around does parturition, others around the lactation peak. Both methods can be technically justified. The aim of this study is to evaluate zootechnical effects of MPG distributed in maternity, according to one or two distributions, and determine the best period to use this product.

MATERIALS AND METHODS

Animals and experimental design

On a commercial farm, 125 multiparous does (≥ 3 parturitions, Hyplus PS19; Hypharm, France) were divided in 3 groups according distribution of MPG in drinking water. A total of 41 does received water including 0,4% (4ml/L) of MPG during 4 days before birth (BB); 44 does received same doses of MPG added to water during 4 days before birth and for 4 days (birth +14 days to birth+18 days) around lactation peak (LP) and other 40 does, as a control group, received water without MPG (C). Water and commercial feed were distributed *ad libitum*. Three days (d3) after parturition, litter size was standardized to 10 kits. At d9, litters were homogenized according kits weight.

Measurements

All does were weighted at d4; d9 and d31 (1 day before weaning d32). Size and weight of litters were controlled at d9, d14, d21, d25 and d31. Mortality was followed on these same dates. Daily temperatures inside the building were recorded. The global water consumption was registered daily for the entire room (656 does) and was specifically registered for the groups which received MPG (during product distribution period).

Statistical Analysis

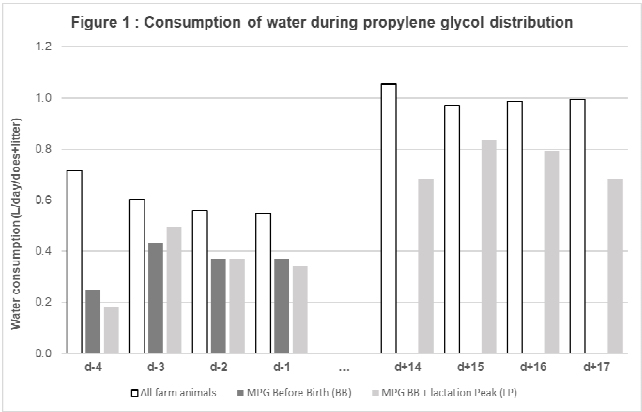
Statistical analysis was realized with software R version 3.5.0. Growing performances (live weight and average daily gain) were analysed with initial weight as a covariate. Mortalities and pregnancy diagnosis were studied using chi square test.

RESULTS AND DISCUSSION

The experiment was carried out during summer (June and July 2018) with sometimes high outside temperatures. Temperatures recorded in the building varied from 15.9 to 28.2°C with an average of 21.8°C.

Effect on water consumption during MPG distribution

The global water consumption of does and litters, during maternity period, was quite low (average 1.25 L/d *vs* 1.55 L/d usually in this farm during all the year). Moreover, during MPG distribution, BB and LP does groups consumed less water than the entire room (**Figure 1,** average -41% BB group and -32% LP group). Water consumption was lowest the first day of MPG distribution (-65% BB and -74% LP). Comparatively, the animals increased their water consumption the second day.



Effect on does and kits mortalities

Does mortalities were unaffected by distribution of MPG (**Table 1**).

Despite a decrease of litter mortality in the 2 groups receiving MPG, the differences in mortality of young rabbits were not significant.

Table 1: Effect of propylene glycol on mortalities in maternity from 9 to 31 days after birth

% of Mortalities	C group	BB group	LP group	*P value*
Rabbits mortalities	2.5%	1.22%	1.14%	NS
Does mortalities	5.88%	6.82%	5.45%	NS

Effect on litters growth and weight performances

Results are shown in **Table 2**. MPG had a significant effect on rabbit weight at 31 days (1 day before weaning). Individual rabbit weights of LP group were lower than the BB and C groups (P<0.05), -27.9 g and -32 g, respectively. There was no difference regarding rabbit weights between BB and C groups. These weight differences were already observed at 25 days in favor of BB group (+44.1 g *vs* C group and +65.7 g *vs* LP group).

Growths were different between 21 to 25d (P<0.01) with a sudden increase of growth of BB group (47 g/d *vs* 34.4 g/d for C group and 32 g/d for LP group). Then C group and LP group had to some extent a compensatory growth during the next period (25 to 31 days). These results showed a potential effect of MPG on energetic metabolism of does when it is distributed around birth. MPG could allow better lactation and therefore better rabbit viability and growth after lactation peak.

The significantly lower average weight of young rabbits observed in LP group at 31 days could be due to the double distribution of MPG and a possible toxic effect after double does consumption.
Indeed, according above description, rabbits' weight was not different before 21 days and differences appeared after the 2nd distribution of MPG (d14 to d17), while rabbits start drinking water usually from 20 days (probably an after effect on rabbits). According low water consumption of LP group, another hypothesis could be that a double distribution of MPG increased an inappetence effect, decreasing water consumption of does and consequently its milk production and which may have affected results. This possible toxic effect has never been demonstrated in the scientist literature. Only few studies focused essentially on a distribution of MPG 4 to 5 days before insemination but not before birth and at lactation peak. The toxic effects have been demonstrated in fattening rabbits with significantly higher doses (18 mg / kg per os; 6 mg / kg intramuscular and 8 mg / kg intravenous) (Ruddick, 1972) and lower growth above 4.2 mg/kg/d of MPG (Braun *et al.*, 1936).

Table 2: Effect of propylene glycol on litters weight and growth

	MPG distribution			*P value*	
	C group	BB group	LP group	P0	Group
Rabbits, no.	400	410	440		
Live weight 9 d (g)	197	191	190	NS	
Live weight 14 d (g)	265	260	258	<0.01	NS
Live weight 21 d (g)	366	360	354	<0.01	NS
Live weight 25 d (g)	503[b]	547[a]	482[b]	<0.01	<0.01
Live weight 31 d (g)	740[a]	735[a]	708[b]	<0.01	<0.05
Weight gain 9 -14 d (g/d)	13.6	13.7	13.5	<0.01	NS
Weight gain 14 -21 d (g/d)	14.4	14.3	13.7	<0.05	NS
Weight gain 21 -25 d (g/d)	34.4[b]	47.0[a]	32.0[b]	<0.05	<0.01
Weight gain 25 -31 d (g/d)	39.4[a]	31.3[b]	37.6[a]	NS	<0.01
Weight gain 9 -31 d (g/d)	24.7[a]	24.7[a]	23.5[b]	<0.01	<0.05

Means with different letters on the same row differ significantly (P=0.05). P0: initial weight as a covariate

Effect on weight and pregnancy diagnosis of does

We recorded a higher decrease of individual does weight in LP Group between 9 to 31 days after birth (-146g *vs* -75g C group and -76g BB group). We did not make the same observations as Luzi *et al.* (2000) who concluded on the improvement of does weight at weaning. But it must be underlined that they had administered the product at different dose and period (2% of MPG 5 days before AI) as an alternative synchronizing method.

On pregnancy diagnosis (d23), the BB group obtained the best rate of females estimated pregnant (79% *vs* 69.7% C group and 69.3% LP group). But these differences were not significant (P=0.34). This is in agreement with results of Luzi *et al*. (1999) and Luzi *et al*. (2000) with respectively +11% fertility rate and +20% of positive results at the following pregnancy diagnosis.

CONCLUSIONS

During summer conditions with high temperatures, MPG positive effect on does weight has not been proven. A distribution of MPG to a doe before parturition had positive effects on fertility diagnosis and on young rabbit weights at 21 days.
It is not advised to distribute MPG a second time during the peak lactation period.
Additional experiments could verify the effect of different MPG dosages and the direct positive impact of this product on the quantity of milk produced by the does.

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