TOWARDS A SUSTAINABLE RABBIT PRODUCTION SYSTEM COMBINING GENETIC TYPE AND WEANING STRATEGY

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ABSTRACT

Current rabbit farming is highly dependent on antibiotics mainly due to digestive disorders during the growing period. To search for more sustainable strategies, in this work we explored the development of growing rabbits from two different genetic types (GTP, characterised by productivity; GTR, characterised by robustness) and two different weaning strategies (weaning at 28 days after parturition plus a solid milk replacer until 49 days, W28; weaning at 49 days, W49). Total milk intake, solid intake, as well as litter size and litter weight were recorded at standardization, 17, 28, 49 and 56 days after parturition on 502 litters. Rabbits weaned at 49 days had higher milk intake than those weaned at 28 days (+197?14 g, *P*<0.001). From day 49 on, litter size in W49 groups was higher than in W28 groups (+0.35?0.17 at 49 days, *P*<0.05 and +0.33?0.17 at 56 days, *P*=0.054). This result suggests that the solid milk replacer had not the same protective role as milk. Young rabbits from GTP had higher milk intake than those from GTR type (+32??14 g, *P*<0.05) but did not differed on solid intake or body weight at any day. Interestingly, litter size at 56 days of GTR was 0.36?0.17 young rabbits higher than GTP (*P*<0.05). Moreover, despite interaction was not significant, litter size was higher in W49 animals than in W28 animals at 49 days (+0.48?0.24, (*P*<0.05) and at 56 days (+0.45?0.24, *P*=0.066). On the contrary, no differences on litter size depending on the weaning system were observed for GTR animals. This result suggests that GTP was less robust than GTR and was benefited by delaying weaning. On the contrary, GTR presented good performance in both weaning strategies as a consequence of their higher robustness. Therefore, combining a low risk diet with early weaning plus a solid milk replacer and GTR crossbreeding scheme could be an interesting strategy to decrease dependence on antibiotics as it balances sanitary risk and productivity.

Key words: Robustness, milk replacer, litter size, productivity.

INTRODUCTION

Antibiotic resistance is one of the most important milestones that the human being will face during the 21st century. Current rabbit farming is highly dependent on antibiotics mainly due to digestive disorders during the growing period (Marlier *et al*., 2003). Consequently, it is mandatory to develop strategies less dependent on antibiotics that not penalize productivity. In this sense, different strategies have been explored (Falcão-e-Cunha *et al*., 2007). Unfortunately, it seems that it will not be possible to find direct substitutes for antibiotics, so new strategies will have to follow a multifactorial approach. Moreover, it has been proved that milk has a protective role against digestive disorders (Gallois *et al*., 2007). As a consequence of these results, several farmers delay weaning until 42 or 49 days of life. However, this strategy that reduce mortality of growing rabbits, has a penalty on productivity of females as it increases interval between parturitions. On the other hand, it has been reported that some genetic types that are equally productive under favourable environmental conditions, are able to be more productive under challenging environments (Savietto, 2014). This type of animals is considered to be more robust. So, the hypothesis of the present work is that growing rabbits from robust genetic types would present good performance independently of the weaning strategy whereas less robust rabbits would be benefited for delaying weaning. Therefore, the aim of the work is to explore the development of growing rabbits from two different genetic types (that differ in productivity and robustness) and two different weaning strategies (that differ in the age at weaning and the use of solid milk replacer).

MATERIALS AND METHODS

Animals and experimental design

A total of 502 litters from the first four reproductive cycles of 160 crossbreed rabbit females were evaluated. These rabbit does were crossbreed females from two different genetic types obtained at Universitat Politècnica de València (UPV). To obtain females for the first group line H was used as the sire line and line A as dam line (81 does). To obtain females for the second group line H was used as the sire line and line LP as dam line (79 does). These crosses have been reported to be the most productive (HxA) or the one with highest robustness (HxLP) due to its functional longevity (Ragab, 2012). Litters for the present experiment were obtained inseminating these crossbreed females with pooled semen from males of the paternal line R (UPV). Consequently, two different genetic types were obtained: litters from genetic type P (GTP) came from the three-way crossbreeding scheme HxAxR and litters from genetic type R (GTR) came from the three-way crossbreeding scheme HxLPxR. At first parturition, each rabbit female was randomly allocated to one of the two different weaning systems: weaning at 28 days after parturition plus a solid milk replacer until 49 days (W28) or weaning at 49 days (W49), so that approximately half of the litters from each genetic type were allocated to each weaning system. At birth, litters were standardized approximately to 8 kits at first parturition and to 10 in subsequent parturitions. From day 17 onwards, litters had free access to water and to a high-fibre/low-protein diet (10.1 MJ of digestible energy per kg of dry matter; 102 g of digestible protein per kg of dry matter; 361 and 217 g of NDF and ADF per kg of dry matter, respectively). At weaning, litters were not homogenized. After weaning, litters from W28 received decreasing amounts of solid milk replacer (6, 4, 3 g/young rabbit and day, offered early in the morning for the 1st, 2nd and 3rd week after weaning, respectively) and consumed in few minutes. The solid milk replacer was based on milk protein concentrate, triglycerides of caprylic and capric acids, vegetable oils and lactose, aiming a nutrient content similar to that of rabbit milk in terms of level of protein, fat and lactose, as well as in the fatty acid profile. Litter size and litter weight were recorded at standardization, as well as 17, 28, 49 and 56 days after parturition. Litter feed intake was recorded at 28, 49 and 56 days after parturition. Daily milk production (four days a week) was measured using the weight(doe)-suckle-weight(doe) method during whole lactation.

Statistical analysis

The curve of lactation for each reproductive cycle from each female was modelled using a 3rd degree polynomial regression. Afterwards, their regression coefficients and the R^2 for each curve were obtained. Finally, daily values were estimated. Individual values per young rabbit for milk intake, weight and feed intake were obtained dividing litter values by its corresponding litter size. Cumulated feed intake and milk intake was calculated summing up individual daily values for the whole period. Data from all the variables was analysed using a linear model (Proc Mixed, SAS) that included the effect of genetic type, weaning system, parity order and its interactions as fixed effects, as well as litter size at standardisation as a covariate. The permanent effect of the mother and the error were considered as random effects. In the analysis of cumulated milk intake per rabbit, we use R^2 as weight variable in order to consider that some daily estimations were more confident than others.

RESULTS AND DISCUSSION

The effect of genetic type and weaning system on development of young rabbits are presented on Table 1. No significant interactions between genetic type and weaning system were detected. Regarding to overall values, cumulated milk intake varied from 553 to 782 g per rabbit and cumulated feed intake varied from 2255 to 2310 g DM per rabbit. Both milk and feed intake agree with normal values reported by Gidenne and Lebas (2006). However, individual weight at 56 days varied 1637 to 1693 g per rabbit and these values were lower than expected. Moreover, litter size at 56 days varied from 7.88 to 8.57, which means that overall mortality of young rabbits averaged 16.0%, without using any antibiotic. This value is comparable to those reported by Coutelet and Hurand (2016) and Corrent *et al*. (2003) in commercial farms where antibiotics are used. These results could be the result of the low risk strategy we used (high-fibre/low-protein diet, delayed weaning in W49 and solid milk replacer in W28). However, lower weights than expected suggests that this low-risk diet had a penalty on growth, probably because of having a digestible protein to digestible energy ratio of only 10.1 g/MJ, lower than that usually recommended, 10.5-11.0 g/MJ (Xiccato and Trocino, 2010).

Regarding to the weaning system, rabbits weaned at 49 days had logically higher milk intake than those weaned at 28 days (+197?14 g, P<0.001). No differences were found for feed intake, nor weight of young rabbits. Considering the higher milk intake of W49, it would be expected a higher feed intake or lower weight of W28 animals. This apparent inconsistency could be explained considering the ingestion of solid milk replacer of W28 animals. Between 28 and 49 days W28 animals ingested 75 g of dry matter from solid milk replacer, while W49 ingested 59 g of dry matter from milk [assuming that the dry matter of milk was 30%, according to Maertens *et al*. (2016)]. At standardization an unexpected effect of weaning strategy appeared on litter size, that was included in the model for statistical analysis as a covariate. Later, no differences among groups were found until 28 days. From this point on, litter size in W49 groups was higher than in W28 groups at 49 days (+0.35?0.17, P<0.05) and at 56 days (+0.33?0.17, P=0.054). This result suggests that the solid milk replacer had not the same protective role as milk.

Table 1: Interaction between genetic type and weaning system on performance of young rabbits at different ages[1]. Least square means and standard errors into brackets.

	GTP		GTR		Contrast	
	W28	W49	W28	W49	GTP-GTR	W28-W49
Cumulated milk intake[2] (g/rabbit)	562(14)	782(14)	553(14)	727(13)	32(14)*	-197(14)***
Cumulated feed intake[2] (g DM/rabbit)	2276(38)	2258(39)	2255(38)	2310(37)	-16(38)	-18(38)
Weight[2] (g/rabbit)						
0dpp	54.2(0.8)	53.3(0.9)	55.1(0.8)	53.6(0.8)	-0.6(0.8)	1.2(0.8)
17dpp	252(4)	254(4)	247(4)	258(4)	1(4)	-7(4)
28dpp	444(7)	446(8)	433(7)	449(7)	4(7)	-9(7)
49dpp	1379(19)	1373(19)	1340(19)	1380(18)	16(19)	-17(19)
56dpp	1680(19)	1691(19)	1637(19)	1693(18)	20(19)	-33(19)
Litter size						
0dpp	9.76(0.05)	9.94(0.05)	9.79(0.05)	9.94(0.05)	-0.01(0.05)	-0.17(0.05)*
17dpp	9.00(0.13)	8.81(0.13)	8.92(0.13)	9.06(0.12)	-0.09(0.13)	0.03(0.13)
28dpp	8.91(0.13)	8.79(0.14)	8.85(0.13)	8.99(0.13)	-0.07(0.13)	-0.01(0.13)
49dpp	7.94(0.17)	8.42(0.17)	8.38(0.17)	8.60(0.16)	-0.31(0.17)	-0.35(0.17)*
56dpp	7.88(0.17)	8.33(0.17)	8.36(0.17)	8.57(0.16)	-0.36(0.17)*	-0.33(0.17)

[1] Interaction between genetic type and weaning system resulted non-significant for all the traits (P>0.05). Consequently, comparisons among groups are not showed on the table. [2] Values per young rabbit: obtained dividing litter value by corresponding litter size. GTP: Genetic type obtained from a crossbred female HxA and pooled semen from R males, characterized by productivity. GTR: Genetic type obtained from a crossbred female HxLP and pooled semen from R males, characterized by robustness. W28: Weaning system where young rabbits were weaned at 28 days and then received decreasing amounts of solid milk replacer until 49 days. W49: Weaning system where young rabbits were weaned at 49 days. dpp. Days post-parturition. * P<0.05, *** P<0.001.

Regarding to the effects of genetic type, young rabbits from GTP had higher milk intake than those from GTR type (+32??14 g, P<0.05) but did not differed on solid intake or body weight at any day. These results are in agreement with those reported by Mínguez *et al*. (2015) who evaluated the progeny of rabbit does from several crosses of maternal lines and did not find important differences between these crosses. Interestingly, litter size at 56 days of GTR was 0.36?0.17 young rabbits higher than GTP (P<0.05), despite higher milk intake of GTP would hypothetically favour a higher litter size for this genetic type. Nevertheless, it has been proposed that robust young rabbits from LP line are more mature physiologically and immunologically at weaning which could help them to cope with growing period with lower sanitary risk (García-Quirós *et al*., 2014). Interestingly, despite interaction was not significant, litter size was higher in W49 animals than in W28 animals (+0.48?0.24 at 49 days, $P<0.05$; +0.45?0.24 at 56 days, $P=0.066$). On the contrary, no differences on litter size depending on the weaning system were observed for GTR animals. This result suggests that GTP was less robust than GTR and was benefited by delaying weaning. On the contrary, GTR presented good performance in both weaning strategies as a consequence of their higher robustness may be associated to a higher physiological and immunological maturity.

CONCLUSIONS

Combining a low risk diet with early weaning plus a solid milk replacer and GTR crossbreeding scheme could be a sustainable strategy as it balances sanitary risk and productivity.

ACKNOWLEDGEMENTS

The authors thank Juan Carlos Moreno for his technical support. The grant for Alberto Arnau from the Ministry of Economy and Finance (BES-2012-052345) is also gratefully acknowledged. This study was supported by the Interministerial Commission for Science and Technology (CICYT) of the Spanish Government (AGL2014-53405-C2-1-P).

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