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EFFECTS OF PMSG INDUCED OESTRUS ON THE PERFORMANCES OF RABBIT DOES : A REVIEW +

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ABSTRACT : Although the rabbit is considered as a mammal with an extreme high reproduction capacity, the irregular alternation of oestrous and anoestrous periods is a disadvantage in view of a regular, synchronized reproduction rhythm. Especially with the increasing use of artificial insemination in rabbit breeding, large groups of females in the same reproductive and physiological stage are likely. However, the receptivity of the doe is largely depending on the hormonal antagonism between prolactin and gonadotropin. In order to solve this problem, last years an increasing use of a Pregnant Mare Serum Gonadotropin (PMSG) treatment, 2 to 3 days before the insemination, became widespread.
The authors reviewed the literature concerning the effects of a PMSG treatment in order to synchronize the oestrus. The following **benefits** generally determined were :
- an increase of the sexual receptivity to the male ; about 90 % accept the male 2-3 days after the treatment.
- especially in lactating non receptive does, receptivity and fertility were significantly increased.
- an increase of the prolificacy ; total litter size: + 5 to 10 %
- positive results on does with reproductive problems.
However, a number of **disadvantages** were found:
- the lack of improvement in non-lactating or receptive does.
- because of antigenic properties, a decrease in fertility after repeated treatments.
- an increase of the mortality rate at birth, probably related to the dosage used.
- a changed distribution of litter size frequencies: large litters (> 12 young) and small litters (<5 young) are more numerous.
Based on these observations, the authors advise to consider the application of PMSG induced oestrus only in relation to the physiological status of the doe and at a low dosage. Limited use on primiparous does and (or) on non-receptive does can help to synchronize the oestrus and to obtain more favourable results in a well organized reproduction scheme. However, further research efforts have to be done in order to optimize feeding, zootechnical and environmental conditions in view of oestrus synchronization and to avoid the systematic use of PMSG.

RÉSUMÉ : Effet de l'induction de l'oestrus par PMSG sur les performances des lapines : un revue.
Bien que le lapin soit considéré comme un mammifère ayant une très grande capacité de reproduction, l'irrégularité dans l'alternance des période d'oestrus et d'anoestrus est un inconvénient lorsque que l'on veut régulariser, synchroniser le rythme de reproduction. D'importants groupes de femelles au même stade physiologique de reproduction sont particulièrement concernées avec l'utilisation croissante de l'insémination artificielle dans l'élevage du lapin. En outre la réceptivité de la femelle est largement dépendante de l'équilibre hormonale entre la prolactine et la gonadotrophine. Afin de résoudre ce problème, ces dernières années ont vu se développer rapidement l'usage de traitement par "Pregnant Mare Serum Gonadotropin" ou PMSG, appliqué 2 à 3 jours avant l'insémination artificielle.
*Les auteurs ont passé en revue la littérature concernant les effets du traitement par PMSG destiné à synchroniser l'oestrus. On peut en déduire les **avantages** suivants :*
- un augmentation de la réceptivité au mâle. Environ 90 % d'acceptation du mâle 2 à 3 jours après le traitement.
- La réceptivité et la fertilité sont significativement augmentées, plus particulièrement chez les femelles allaitantes ou non réceptives
- une augmentation de la prolificité ; taille de la portée : + 5 à 10 %.
- résultats positifs pour les femelles ayant des problèmes de reproduction
*Cependant un certain nombre de **désavantages** ont été relevés :*
- l'absence d'amélioration pour les femelles non allaitantes et réceptives.
- une diminution de la fertilité après des traitements répétés causée par des propriétés antigènes.
- un augmentation du taux de mortalité à la naissance probablement due aux doses utilisées.
- une répartition modifiée de la fréquence d'apparition des tailles de portées : les très grandes portées (>12 lapereaux) et les très petites (<5 lapereaux) sont plus nombreuses.
En tenant compte de ces observations les auteurs recommandent de n'utiliser le traitement par PMSG pour induire l'oestrus qu'en fonction du statut physiologique de la lapine et en dose faible. Une utilisation limitée aux lapines primipares et/ou aux lapines non réceptives peut aider à synchroniser l'oestrus et à obtenir de meilleurs résultats dans un schéma de reproduction bien organisé.
D'autre part des recherches plus approfondies doivent être menées pour optimiser l'alimentation, les conditions zootechniques et environnementales afin d'obtenir la synchronisation de l'oestrus et d'éviter l'utilisation systématique de PMSG.

INTRODUCTION

The physiology of the rabbit, an animal that has been used during several decades both for zootechnical purposes and laboratory research as well, has always been of notable interest. HAMMOND and MARSHALL (1925), in their book "Reproduction in the Rabbit", putted forward the first oestrus theories about this species. Later on, different theories about the oestrus

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cycle of does were formulated (TORRES, 1977). An explanation can be found in the large variability in oestrus behaviour of female rabbits. A regular oestrus cycle does not exist (MORET, 1980 ; HULOT and MARIANA, 1988) but irregular periods of oestrus and anoestrus alternate depending mainly of the physiological status of the doe and the environmental conditions (HAHN and GABLER, 1971 ; NORDIO-BALDISSERA C., 1980).

With growing interest in rabbit meat production, first attempts were done to introduce artificial insemination (AI) as reproduction system (PAUFLER *et al.*, 1979 ; SCHLOLAUT *et al.*, 1980). The does were inseminated every 33 days, thus during the post partum oestrus period. However, mainly for practical work organization an insemination interval of 42 days is preferable (LAMMERS and PETERSEN, 1988). This reproduction system is now, with the increasing use of AI in the main rabbit meat producing countries (Italy, France, Spain), widely used in order to organize a weekly, biweekly, tri-weekly or six-weekly cycle.

However, the irregular alternation of oestrus and anoestrus periods is a disadvantage in view of a regular, organized reproduction rhythm. Especially when using AI, large groups of females in the same reproductive and physiological stage are likely. Because of the hormonal antagonism between prolactin and gonadotropin, the receptivity of does is a problem during the lactation period (THEAU-CLÉMENT *et al.*, 1990, REBOLLAR *et al.*, 1992 ; THEAU-CLÉMENT and ROUSTAN, 1992). In order to solve this problem, last years an increasing administration of the exogenous gonadotrophin Pregnant Mare Serum Gonadotropin (PMSG), 2 to 3 days before the insemination, became widespread.

PMSG has a hormonal follicle stimulating and luteinizing action. It is a glycoprotein produced in the endometrial trophoblastic cells (KALTENBACH and DUMM, 1984) with a high content of sialic acid that increases the halflife (SCHERWOOD and MCSCHANE, 1977). It has been shown that PMSG produces an increased number of preovulatory follicles (PINGEL *et al.*, 1981 ; BONANNO *et al.*, 1990).

Last years, lots of results were published regarding the use of PMSG in order to improve the physiological conditions of the does, the maturation of the ovary follicles and the receptivity to the male. The objective of the present review is to summarize the benefits of this treatment but also to discuss the limits and the disadvantages.

1. Effect on the receptivity to the male

Does treated with PMSG showed a significant ($P<0.01$) higher response to coitus both for nulliparous does (MORIN *et al.*, 1976 ; MAERTENS *et al.*, 1983) as for multiparous does (KHALIFA *et al.*, 1990 ; MANCHISI *et al.*, 1990 ; THEAU-CLEMENT and LEBAS, 1994).

Vulva colour changes indicating oestrus behaviour have been shown after PMSG treatment (MAERTENS *et al.*, 1983 ; MANCHISI *et al.*, 1988 ; BONANNO *et al.*, 1991). A significant lower number of does with pale vulva were observed while does showing red and purple vulva were much more numerous. The positive relationship between the intensity of the vulva colour and the receptivity, fertility and prolificacy has been demonstrated in several studies (MAERTENS *et al.*, 1983 ; THEAU-CLÉMENT *et al*, 1990 ; BONANNO *et al.*, 1990 ; MAERTENS and LUZI, 1995a).

In most experiments around 90 % of the does accept service 2 days after the treatment (MORIN *et al.*, 1976 ; MAERTENS *et al.*, 1983 ; MANCHISI *et al.*, 1988, 1990 ; KHALIFA *et al.*, 1990 ; GARCIA-XIMENEZ and VICENTE, 1990 ; MIRABITO *et al.*, 1994) while THEAU-CLÉMENT and LEBAS (1994) report only 75.1 % versus 37.8 % for controls. However, the response is largely depending of the physiological status and reproduction cycle. Treatment of does, which show a general good acceptance to service (nulliparous, non-lactating does), results in less pronounced increment of receptivity (THEAU-CLÉMENT and LEBAS 1994). On the other hand PMSG treatment of non-receptive does is much more favourable than forced mating (THEAU-CLÉMENT and ROUSTAN, 1992 ; ARMERO *et al.*, 1994).

Although the positive effect on receptivity, conception rate (CR) is sometimes not higher in PMSG treated does. Receptive does showed comparable CR with controls (THEAU-CLÉMENT and LEBAS, 1994, MIRABITO *et al.*, 1994) while only non-receptive does showed a higher CR compared to controls when using artificial insemination. However, we did not found an experiment in which receptivity was tested before and after the PMSG treatment. In this case it would be possible to separate the effect of PMSG treatment on initially receptive and non-receptive does and to compare them with untreated does. Negative effects of PMSG on CR (MAERTENS *et al.*, 1983) could probably be the response of does who are in oestrus at the moment of the treatment.

2. Effect on the fertility

In most comparative experiments, an overall increased fertility rate was obtained when does were treated, 2 to 3 days before the insemination or mating with PMSG (MORIN *et al.*, 1976 ; PINGEL *et al.*, 1981 ; MANCHISI *et al.*, 1990 ; KHALIFA *et al.*, 1990 ; CASTELLINI *et al.*, 1991 ; BOURDILLON *et al.*, 1992 ; BONANNO *et al.*, 1993 ; BERSÉNYI, 1994 ; DAVOUST, 1994 ; THEAU-CLÉMENT and LEBAS, 1994). Favourable results are also reported under field

Table 1 : Effect of PMSG treatment on fertility of does according to their physiological status (THEAU-CLEMENT and LEBAS, 1994).

		PMSG group		Controls		Significance
		Number	Fertility (%)	Number	Fertility (%)	
Lactating :	receptive	261	75.9	102	80.4	NS
	non receptive	65	53.9	189	38.1	P<0.05
Non-lactating :	receptive	94	83.0	86	88.4	NS
	non receptive	53	66.0	120	66.7	NS

conditions (LE BRETON *et al.*, 1994). However, PMSG failed in some experiments (BONANNO *et al.*, 1991 ; MIRABITO *et al.*, 1994) to increase the CR and even sometimes a negative response was obtained (REMMEN *et al.*, 1979 ; MAERTENS *et al.*, 1983 ; CASTELLINI *et al.*, 1991 ; ALABISO *et al.*, 1994).

The response to the PMSG treatment appears to be dependent on the ovarian condition of the doe at the moment of administration (BONANNO *et al.*, 1990). Differences in response can therefore mainly be explained by the physiological status of the does. Significantly increased CR were obtained with lactating does (BOURDILLON *et al.*, 1992 ; DAVOUST, 1994 ; DAVOUST *et al.*, 1994) especially when the does were not receptive to the male (THEAU-CLÉMENT and LEBAS, 1994). The results of this last authors are presented in Table 1.

The hormonal antagonism between prolactin and gonadotropin is responsible for the lower CR with lactating compared to non-lactating does (REBOLLAR *et al.*, 1992 ; THEAU-CLÉMENT and ROUSTAN, 1992). Especially in primiparous does, this hormonal antagonism is aggravated by the large energy deficit during the lactation (PARIGI-BINI *et al.*, 1990). For these reasons PMSG treatment of lactating primiparous does results in fertility rates twice as high as in non-treated primiparous does (BOURDILLON *et al.*, 1992 ; DAVOUST, 1994). On the other hand, nulliparous does, non-lactating does or even multiparous does showing a good receptivity to the male have a sufficient oestrogen release and follicular growth resulting in a high ovulatory response (THEAU-CLÉMENT and POUJARDIEU, 1994). Consequently no improvement of the ovulatory response has been observed after a PMSG treatment of such does (GOSALVEZ *et al.*, 1994) and no increment of the fertility was obtained (MAERTENS *et al.*, 1983 ; BOURDILLON *et al.*, 1992 ; MIRABITO *et al.*,1994 ; THEAU-CLÉMENT and LEBAS, 1994).

Thus the success of the PMSG treatment is largely depending on the hormonal status of the does as recently was demonstrated by ARMERO *et al.* (1994). In favourable season the CR was comparable with the untreated does. However, in unfavourable season PMSG treatment improved significantly the fertility rate (92.0 % vs 79.4 %). When does shown a low response to mating, PMSG treatment results in significant increased fertility rates (KHALIFA *et al.*, 1990 ; THEAU-CLÉMENT and LEBAS, 1994 ; ARMERO *et al.*, 1994). PMSG has further been used successfully in farms to overcome reproductive problems (REMMEN *et al.*, 1979 ; KHALIFA *et al.*, 1990).

Especially when artificial insemination is performed, a synchronized oestrus is necessary. Instead of treating all does, a selective use of PMSG seems likely. When PMSG was used on non-receptive does only, a more favourable fertility was obtained than systematic use (ALABISO *et al.*, 1994). The results of DAVOUST *et al.*, (1994) support the selective use of PMSG. They treated systematically the lactating does 2 days before insemination. In this way fertility rate of the total unit was on average 76 % during a period of 17 months. Probably PMSG treatment can even be restricted to primiparous does (BOURDILLON *et al.*, 1992) or to non-receptive does in order to synchronize the oestrus.

However, the determination of the does' receptiveness is time consuming and therefore not useful in practice. Although the colour of the vulva is not a 100 % valid predictor of receptivity, many experiments have demonstrated the good relationship with receptivity to the male and/or fertility rate (MAERTENS *et al.*, 1983 ; MANCHISI *et al.*, 1988 ; BONANNO *et al.*, 1991 ; THEAU-CLÉMENT *et al.*, 1992 ; MAERTENS and LUZI, 1995a). Therefore it could be suggested to treat only does showing a pale vulva 2 days before the intended insemination. In this way a synchronized oestrus, with increased CR, could be obtained with a reduced application of PMSG (BONANNO *et al.*, 1995).

3. Effect on the prolificacy

The effect of PMSG treatment on litter size is summarized in Table 2. Mentioned data are averages. When data were related to the physiological status of the doe, differences were sometimes more pronounced.

Table 2 : Effect of PMSG treatment on prolificacy of does (total born or alive born / litter)

	TB or AB *	Controls	PMSG	Difference	Stat. Sig.
MORIN *et al.*, 1976	AB	8.7	10.55	+ 21.2 %	?
PINGEL., 1981	AB	7.5	9.4	+ 25.3 %	?
MAERTENS *et al.*, 1983	TB	8.02	9.12	+ 13.7 %	P<0.05
KHALIFA *et al.*, 1990	TB	7.4	7.6	+ 1.3	NS
BONANNO *et al.*, 1991	TB	6.68	7.14	+ 6.7	NS
CASTELLINI *et al.*, 1991	AB	8.33	8.59	+ 3.1 %	NS
BOURDILLON *et al.*, 1992	TB	10.37	11.27	+ 8.7 %	P<0.05
BONANNO *et al.*, 1993	TB	7.1	6.9	- 2.8 %	NS
ALABISCO *et al.*, 1994	TB	7.8	7.6	- 2.5 %	NS
MIRABITO *et al.*, 1994 (overall)	AB	10.1	10.5	+ 4 %	NS
(lactating does)	AB	9.7	10.7	+ 10.3 %	P<0.05
THEAU-CLEMENT and LEBAS, 1994	TB	9.5	10.2	+ 7.4 %	P<0.01
BERSENYI, 1994	TB	8.42	8.67	+ 3.0 %	NS
DAVOUST, 1994.	TB	8.61	9.60	+ 11.5 %	P<0.10
MAERTENS and LUZI, 1995b	TB	8.73	9.10	+ 4.3 %	NS

* TB : total born/litter ; AB : alive born

In lactating does differences in favour of the PMSG treated does were much more pronounced (+ 1 young/litter) compared to non-lactating does (DAVOUST, 1994 ; MIRABITO *et al.*, 1994). When only primiparous does were considered, an increase of even 3 kits/litter was observed by BOURDILLON *et al.* (1992).

However, a PMSG treatment in order to stimulate follicular growth has some negative effects. The average increase of about 1 young/litter was in some experiments associated with a significant higher mortality rate at birth (MAERTENS *et al.*, 1983 ; MANCHISI *et al.*, 1990 ; ALABISO *et al.*, 1994 ; MAERTENS and LUZI, 1995b) or more totally lost litters (BONANNO *et al.*, 1995 ; MAERTENS and LUZI, 1995b). In our experimental unit a mortality rate at birth of 14.1 % was observed in litters of PMSG treated does while this rate was only 6.2 % in controls. This result is consistent with ALABISO *et al.* (1994) who observed a comparable increase (25 % instead of 8 % for controls) when a dosage of 40 IU was used.

Higher birth mortality was only observed at quite high dosages (30 to 40 IU). A possible dose response effect could be suggested. The increased birth mortality could partly be explained by the distribution of the litter size (Fig. 1). More small and large litters were obtained after PMSG treatment. Because mortality rate was higher in these litters, the changed distribution of the litter size is partly responsible for the increased birth mortality (MAERTENS and LUZI, 1995b).

Especially litters with less than 5 young and more than 12 young were more numerous (P<0.01) in PMSG treated does (MAERTENS and LUZI, 1995b) which well agrees with our previous work (MAERTENS *et al.*, 1983) and recent work of GOSALVEZ *et al.* (1994). These last authors found in one third of their PMSG treated does only one to three corpora lutea while 3 out of 12 does had 16 or more corpora lutea. However, they used a dose of 100 IU, which is far above the level normally used in breeding does (20 till 40 IU). At this high dosage, they found a negative effect on the quality of the growing follicles.

Another explanation, for the increased number of not viable embryos after PMSG treatment, can be searched in the quality of the embryos. BOITI *et al.* (1995) found a significant higher number of haemorrhagic follicles in treated does while the number of good quality embryos was significantly higher in control does and that of degenerated embryos significantly lower, in line with the reduced embryo volumes recovered from superovulated donors (CARNEY and FOOTE, 1990). Also the in vitro embryo development seems to be impaired when recovered on PMSG treated does (STRADAIOLI *et al.*, 1993). However, the administration of anti-PMSG reduced the incidence of haemorrhagic follicles induced by PMSG stimulation (VERINI SUPPLIZI *et al.*, 1994). Finally the immune status of the does showed to have a highly significant effect on the litter size (BOITI *et al.*, 1995). After 3 or more PMSG treatments, hyper-immune and hypo-immune does gave birth to 7.3 and 9.7 young per litter, respectively.

4. Effect of the dosage and time interval

In the range between 20 till 40 IU of PMSG, no improvement of the response has been found with increasing dosage (KHALIFA *et al.*, 1990 ; ALABISO *et al.*, 1994 ; BONET *et al.*, 1995). Taking into account the above mentioned birth mortality rate at higher dosages,

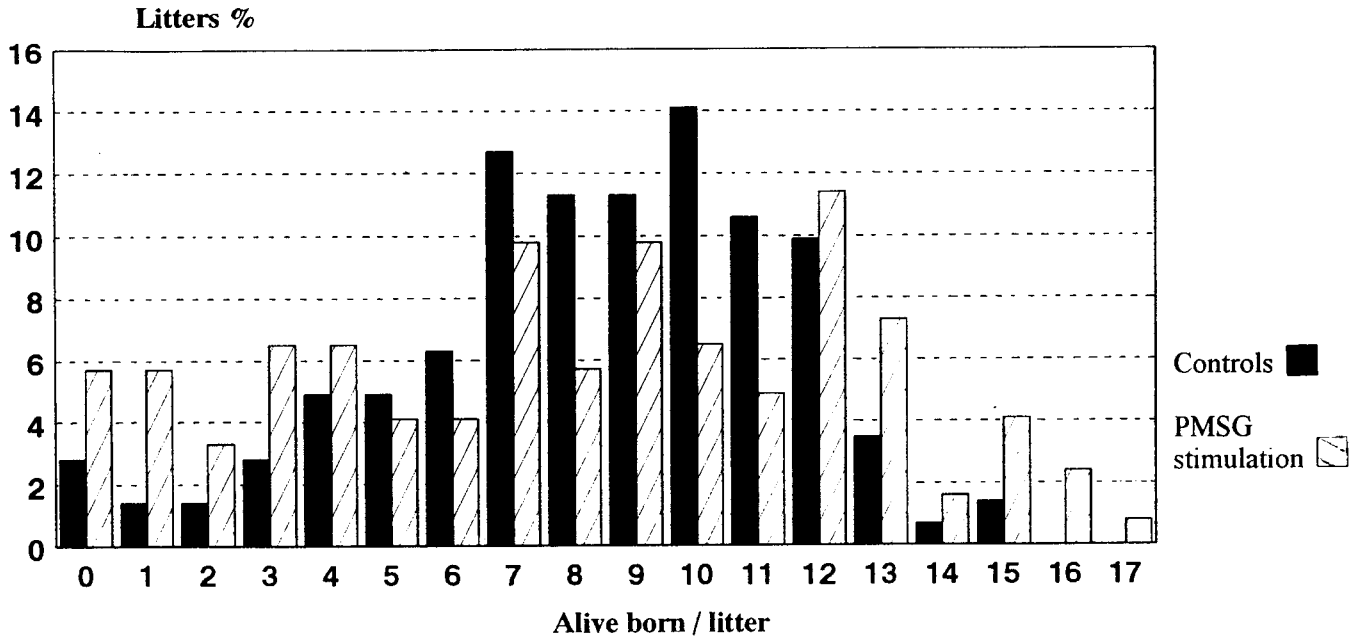

Figure 1 : Distribution of litter size frequencies (alive born) in does stimulated or not with PMSG (Maertens and Luzi, 1995b).

a dosage of 20 IU is enough to obtain the intended oestrus induction. When infertile does were treated, a dosage of 12.5 IU seems not enough to increase fully the receptivity to the male (KHALIFA *et al.*, 1990). At low dosage (4 IU) a significant lower number of mature follicles was found compared to 15 IU (BONANNO *et al.*, 1990). Treatment with 10 IU PMSG resulted only in a tendency to lower follicle numbers (BONANNO *et al.*, 1990).

However, the work of DAVOUST *et al.* (1994), who used a combination of PMSG and HCG, suggest that the normally used dosage (20 IU) in breeding units is high enough. They obtained comparable results when using the combination 8 IU PMSG + 4 IU HCG instead of the double dose.

In most experiments, treatment with PMSG is performed 2 days before the intended mating or insemination. Only limited work is executed in order to optimize the time interval between treatment and insemination. Twenty four hours interval seems too short to have sufficient follicular growth (GARCIA-XIMINEZ and VICENTE, 1990) and resulted in lower receptivity to the male (BONET *et al.*, 1995). An interval of 48h or 72h hours did not have significant effects on fertility rate (BONANNO *et al.*, 1991) or ovulation rate (GARCIA-XIMINEZ and VICENTE, 1990).

5. Effect of repeated use

Antibody generation by repeated PMSG treatments has been demonstrated by CANALI *et al.* (1991) and BOURDILLON *et al.* (1992), resulting in decreased fertility after repeated use (CASTELLINI *et al.*, 1991). CANALI *et al.* (1991) have shown that when repeated doses of 40 IU PMSG were given 2 days before the insemination, there exist a significant negative correlation between fertility and antibody titre against PMSG ($r = -0.41$) but also with the number of insemination ($r = -0.45$). Antibody concentration was further negatively correlated with the time lapse between treatments ($r = -0.51$) as already longtime known when other exogenous gonadotrophins like hCG are used (GREENWALD, 1970). Therefore, the antibody response is higher in not always pregnant does (short interval between injections). However immune response seems to vary strongly between individuals (CANALI *et al.*, 1991 ; BOURDILLON *et al.*, 1992 ; BOITI *et al.*, 1995).

BOITI *et al.* (1995), could discrimate hyper-immune does (optical density, corrected from untreated rabbits >50) and hypo-immune does which showed optical density in their diluted sera less than 50. Sixteen percent of the PMSG treated does developed no immunological response (Fig. 2). All other does were responsive and showed a significant increase of anti-PMSG circulating antibodies with increasing number of inoculations. The receptivity tests of BOITI *et al.* (1995) suggest that the oestrus synchronization effect of PMSG is not negatively influenced by anti-PMSG circulating antibodies. These results confirm the lack of decrease in receptivity of does as found by THEAU-CLÉMENT and LEBAS, (1994) and ALABISO *et al.* (1994). However, both fertility and litter size of

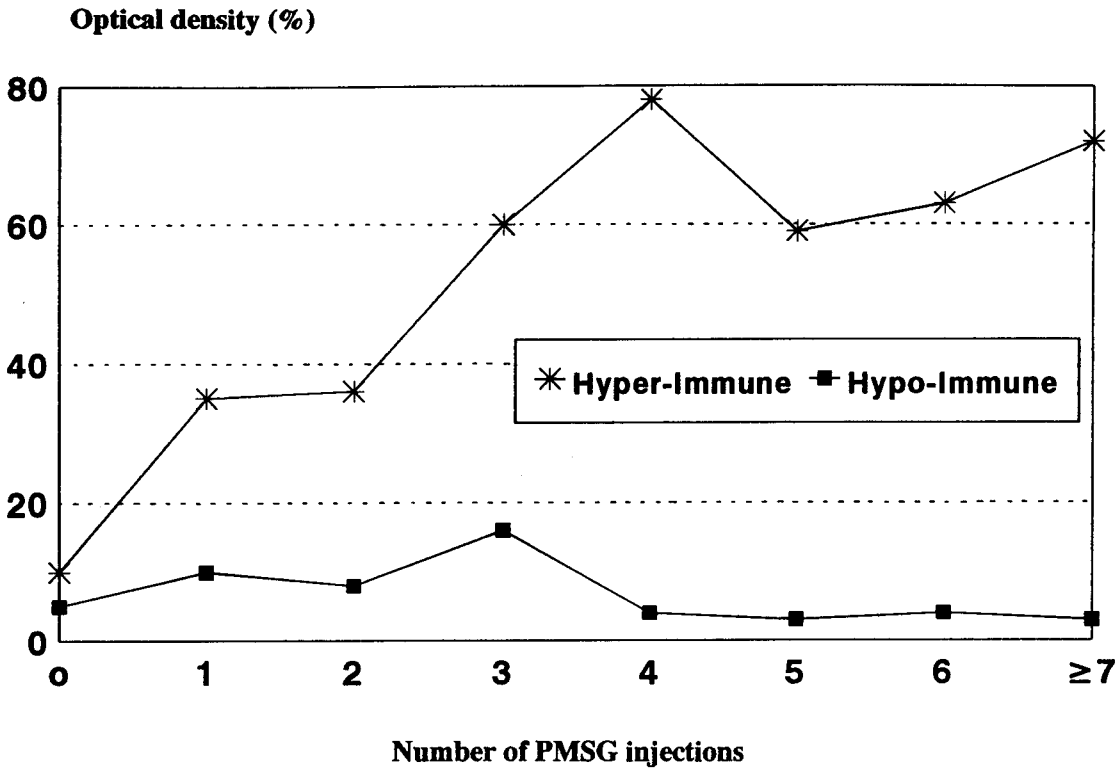

Figure 2 : Anti-PMSG antiboby levels following repeated treatments (BOITI *et al* ., 1995).

hyper-immune does decreased with repeated treatment, while those of the hypo-immune group showed no particular trend (BOITI *et al.*, 1995).

However, in many experiments (BONANNO *et al.*, 1991 ; BOURDILLON *et al.*, 1992 ; THEAU-CLÉMENT and LEBAS, 1994 ; ARMERO *et al.*, 1994) or under commercial management conditions (CECCHINI *et al.*, 1992 ; LE BRETON *et al.*, 1994 ; DAVOUST *et al.*, 1994) fertility rates were not affected by repeated use. This can partly be explained by the high replacement level of does (100 to 130 % / year), which means that about 40 to 50 % of the does are replaced before the development of immunity occurs.

In conclusion, when only primiparous or non-receptive does are treated, as suggested above, the problem of immune response against this molecule is not a serious problem in breeding units.

6. Effect on the other related traits

The first reviewed work on PMSG (MORIN *et al.*, 1976) reported a very high number of does with reproduction problems. However, in long-term experiments (BONANNO *et al.*, 1993 ; THEAU-CLÉMENT and LEBAS, 1994) or in breeding units (LE BRETON *et al.*, 1994) no tendency to increased replacement level was found when does were systematically treated with PMSG.

Weaning weight of youngs in the PMSG treated does were significantly lower even after a correction for the increased litter size (THEAU-CLÉMENT and LEBAS, 1994). However, MIRABITO *et al.* (1994) obtained a comparable litter weaning weight. Pre-weaning mortality seems not to be influenced by the use of PMSG. Also BONNANO *et al.* (1995) did not observe, in an 11 month experimental period, significant differences between does "selectively" treated with PMSG and not treated does both in milk production or single rabbit weight at 21 days as well. Systematic use of PMSG during 9 months seems not to deteriorate the initial fertility because, THEAU-CLÉMENT and LEBAS (1994) obtained the same fertility rates in the post experimental period as in the pre-experimental period.

7. Some final considerations

In selection units, systematic use of PMSG to synchronize the oestrus has to be avoided because does are not more selected for optimal natural fertility. Natural fertility could drop into the reproduction stock because does who respond optimal to PMSG treatment will give birth to the next generation. However, increasing use is made of hybrid reproduction stock in breeding units. Genetic selection is no longer performed at the level of the breeding unit and thus the application of PMSG induced oestrus does not interfere directly with the selection.

The systematic use of induced oestrus can further be criticized taking into account the animal welfare. PMSG treatment provokes follicular growth even in

situations that does normally have a weak oestrogen release (e.g. primiparous does). They are forced to cycle instead of a natural anoestrus period.

Finally rabbit meat risk to lose the image of "natural" meat, although the use of a PMSG treatment has no impact on meat quality as anabolic steroids do.

Based on these considerations and taking into account the above discussed efficiency, PMSG treatment can only be advised in relation to the physiological status of the does. Limited use on primiparous does and (or) on non-receptive does can help to synchronize the oestrus and to obtain more favourable results in a well organized reproduction scheme. However, because of the severe energy deficit of lactating primiparous does, a reduced reproductive rhythm could be suggested. An insemination after weaning of these young does is much more adapted at there body condition instead of trying to increase the intensity of reproduction with a PMSG stimulation. In a cycled or grouped production system, non receptive does have to be treated 2 days before the intended insemination otherwise it complicates very much the organized production.

Further research efforts have to be done in order to optimize feeding (e.g. flushing), zootechnical (PAVOIS *et al.*, 1994) and environmental conditions (e.g. light schedules) in view of oestrus synchronization and to avoid the systematic use of PMSG.

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