BODY CONDITION SCORE AND RELATED PRODUCTIVE RESPONSES IN RABBIT DOES

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ABSTRACT

A simplified 3-point scale method for *in vivo* scoring body condition is proposed as an useful and rapid tool to support experimental and on-farm management of nutrition and reproduction of rabbit does. The productive responses of lactating rabbit does scored and inseminated at 11 days *post partum* (pp) are verified, as well as performance of non-pregnant does scored and re-inseminated at 32 days pp when non-lactating. After their first parturition, 96 New Zealand White rabbit does were checked for 126 days over three successive 42-day reproductive cycles. The body condition scoring was based on feel by hand the loin and the rump for bone protrusions and muscle fullness. The loin was evaluated for poor, intermediate and wide level, the rump for poor and wide level. The body condition was scored "0" with poor loin; "1" with intermediate loin and poor rump; "2" with intermediate and wide loin and wide rump. The highest fertility was obtained with intermediate body condition score (BCS) for both lactating (52.0, 84.9 and 58.6% for BCS 0, 1 and 2; $P<0.001$) and non-lactating does (53.1, 84.4 and 64.5% for BCS 0, 1 and 2; $P<0.05$), indicating the negative effect of poor or excessive body fatness. A poor BCS led to lower litter size at birth in lactating (7.2, 8.2 and 8.3 for BCS 0, 1 and 2) and non-lactating does (8.4, 11.1 and 9.6 for BCS 0, 1 and 2; $P<0.05$), and higher losses of kits from day 1 to 11 of nursing (10.3, 2.2 and 4.5% for BCS 0, 1 and 2; $P<0.001$). The main part of does culled for infertility (44.4%) or death (46.7%) showed the BCS 2. When lactating does resulted non-pregnant at an 11-day artificial insemination (AI), their frequency in the BCS 2 showed a higher increase from parturition to AI (from 30.8 to 52.2%) than they were pregnant (from 26.8 to 37.7%). The lactating does that were non-lactating in the previous cycle showed a higher incidence at BCS 2 (54.8%) than they were lactating (43.8%) or nulliparous (39.6%). These latter indications suggest that failures in fertility at 11-day AI and culling rate are imputable more to the excessive body fatness of does than to their poor body condition.

Key words: Rabbit doe, Body condition score, Reproduction, Artificial insemination, Fertility.

INTRODUCTION

In intensive farms, the rabbits does, being artificially inseminated (AI) at 4 or 11 days *post partum* (pp), are lactating and gestating at the same time. In this condition, especially in primiparous does, the high nutritional needs are not completely satisfy by feed intake, the energy balance is negative and the body fat depots are mobilized (Fortun-Lamothe, 1998; Xiccato *et al*., 2004). This nutritional status results in poor body condition and low reproductive performance, that are the primary causes of brief life-span of rabbit does, due to either culling or death (Fortun-Lamothe, 2006). Also an excess body fatness leads to negative consequences on reproduction (Rommers *et al*., 2004; Theilgaard *et al*., 2006). Since the reproductive capacity in rabbits does depends on their nutritional status (Feugier *et al*., 2005; Brecchia *et al*., 2006; Castellini *et al*., 2006; Fortun-Lamothe, 2006), a reliable method for *in vivo* evaluating and scoring the body condition could be of great interest in supporting experimental and on-farm reproductive management of rabbits does. Recently, Cardinali *et al*. (2008) demonstrated that the body condition of 11-day lactating rabbit does, *in vivo* scored according to a 5-point scale (from 0 to 4) as proposed by Bonanno *et al*. (2005), was more related with the body fat depots and the lipid content of muscle samples and empty body than with body weight. Moreover, lactating rabbit

does having an extreme body condition score (BCS) (0, 1 and 4 points) at an 11-day AI showed lower plasma FSH levels, less evident preovulatory LH surge and lower sexual receptivity and fertility rate than does with intermediate BCS. This method of BCS attribution, being rapid, non-invasive and less stressing for animals, appeared a valid tool to examine the fatness status of rabbit does in function of their expected reproductive performance. Since the intermediate BCS levels corresponded to the same body status and reproductive performances of rabbit does, their classification under an unique score should be more appropriate.

In this study, a simplification of this BCS method is proposed by reducing the scoring from a 5-point scale to a 3-point scale. The adequacy of this simplified BCS is verified in terms of reproductive and productive responses of lactating rabbit does scored and inseminated at 11 days *post partum* (pp) and of non-pregnant does at an 11-day AI, scored and re-inseminated at 32 days pp when non-lactating. The changes in BCS are examined along the reproductive cycle of lactating does when pregnant or non-pregnant at AI.

MATERIALS AND METHODS

Animals, management and experimental design

This experiment, carried out during April-August 2007, involved 96 New Zealand White primiparous rabbit does that were monitored as from their first parturition over three successive 42-day cycles (126 days). Rabbit does were held on a farm in Sicily into flat-deck cages, under a light program of 16 h/d, a temperature of 18-22°C and a relative humidity of 60-75%. They were fed 180 g/d of a commercial diet (10.9 MJ/kg DE, 19.2% CP and 25.0% ADF on a DM basis) when dry or *ad libitum* when lactating. A 42-day reproductive cycle was followed (AI at day 11 pp), using 2 batches of does inseminated at 21-day intervals. Non-pregnant does were inseminated again 21 days later, at day 32 pp. The AI was performed with 0.5 ml of heterospermic fresh semen diluted 1:8 in a commercial extender (Cortalap, IMV Technologies, Piacenza, Italy). Ovulation was induced at AI by i.m. injection of 0.8 μg of synthetic GnRH (buserelin, Suprefact, Aventis Pharma, Milano, Italy). At parturition, litter size was equalised to 8 kits. Controlled suckling for 10 min was adopted during 1-12 days pp; AI and GnRH injection were executed within 15 min after suckling. The litters were weaned at 28 days of age.

Measurements

BCS was attributed at day 1, 11, 21 and 28 pp to lactating rabbit does, and day 32 pp (at AI) to previously non-pregnant does. The scoring was based on feel by hand loin and rump regions (Bonanno *et al*., 2005). The loin was felt for vertical bone protrusions (spinous process) and fullness of muscle over and around the vertebrae, and the rump for bone protrusions and fullness of muscle. The loin was subjectively evaluated according to poor, intermediate or wide level, whereas the rump for poor or wide level. The body condition was scored “0” if loin was poor; “1” if loin was intermediate and rump was poor; “2” if loin was intermediate or wide and rump was wide. Sexual receptivity (receptive/inseminated does×100) was estimated at AI by observing the vulva colour and turgidity; a doe was judged receptive when its vulva was red or purple and turgid. Fertility was calculated as kindling rate (parturitions/inseminations x 100). At parturition, number of total born and live-born kits per litter was recorded. Size and weight of litters were checked at day 1 (after equalisation), 11, 21 and 28 pp. Lactating does were weighed at day 1, 11 (after nursing), 21 and 28 pp, and previously non-pregnant does at day 32 pp (at AI).

Statistical analysis

The data were analysed using the GLM procedure of SAS 9.1.2 (2004). Parameters were separately analysed for lactating and non-lactating does by a linear model including the effects of BCS (B: 0, 1 and 2), parity (P: 1 and 2-3) and the interaction B * P. The effects of pregnancy (PR: pregnant and non-pregnant does) and the interaction B * PR were also considered when pertinent. When non-significant, interactions were omitted in the model. Proportional data were considered as variables of Bernoulli (0-1). Comparisons betweens means were done by Student "t" test at a 0.05 significance level.

RESULTS AND DISCUSSION

The BCS at day 11 pp affected sexual receptivity and fertility of lactating rabbit does (Table 1), which were higher with the BCS 1 than with the extreme values. These results, in accordance with Cardinali *et al*. (2008), point out the negative effect on fertility of poor or excessive fatness in rabbit does. Primiparous does showed lower receptivity (75.0 vs. 86.1%, P<0.05) and fertility (54.5 vs. 75.8%, P<0.001) than in multiparous does, regardless of their BCS. Litter size at birth was not influence by BCS, even thought prolificacy was higher by 1 kit with BCS 1 and 2, to which corresponded a higher mortality at birth. However, the kits from does with BCS 1 were heavier at birth. At day 11 pp, body weight of lactating does showed a positive trend with BCS. The weight changes of does over the 42-day cycle were linked to BCS and parity. From day 1 to 11, the weight gain was consistent in does with BCS 1 and 2 and negligible in does with low BCS. From day 11 to 21, these latter were able to recover their weight, showing an higher weight gain than does in better body condition. The weight changes were irrelevant until day 28 and negative from day 28 to 42 (at parturition) for all of does. Even thought the BCS did not influence the growth of nursed kits, the lactating does with low BCS nursed a smaller litter, due to higher kits mortality during 1-11 days. Parity affected kits mortality in the early nursing, being lower in primiparous does than in does with parity 2-3 (1.2 vs. 10.1%, P<0.001), especially when BCS was low (0 vs. 20.5%; P<0.001).

Table 1: Effect of body condition score (BCS) of lactating rabbit does at day 11 *post partum* on their reproductive performance and body weight changes, and kits growth and mortality (LSM)

	Days	BCS			Significant effects (1)	RMSE
	pp	0	1	2		
Inseminations (n)		31	91	94		
Receptivity (%)		64.7 b	93.0 a	84.0 a	B***, P*,	33.6
Fertility (%)		52.0 b	84.9 a	58.6 b	B***, P***	42.8
Total born kits per litter (n)		7.2	8.2	8.3		2.6
Live-born kits per litter (n)		6.8	6.9	6.9		3.2
Mortality at birth (%)		3.2 b	15.3 a	19.4 a	B***, PxB**	35.0
Kit weight at birth (g)		59 b	67 a	62 b	B*	13.5
Doe body weight (g)	11 (AI)	3796 c	3997 b	4147 a	B***, P*	304
Doe body weight change (g)	1-11	18.3 b	147 a	171 a	B***	174
	11-21	278 a	213 ab	185 b	B*, P***, PR*	166
	21-28	-10.8	-41.4	-18.1	PR***	164
	28-42	-286	-369	-409	P**	223
Litter size (n)	11	7.2 b	7.8 a	7.7 ab	B*, P***, PxB*	1.2
	21	6.8	7.5	7.3	P*	1.4
	28	6.7	7.4	7.2		1.5
Mortality (%)	1-11	10.3 a	2.2 c	4.5 b	B***, P***, PxB***	19.9
	11-28	7.2	7.4	6.3		24.6
Kit weight (g)	1	61	61	60	P***	10.6
	28	551	565	570	P***, PRxB*	62.3
Kit weight gain (g/d)	1-11	11.3	11.7	12.0	P*	2.2
	11-21	15.5	15.6	15.8	P***	3.0
	21-28	29.8	30.5	31.1	PRxB*	6.2

(1) B= BCS; P=parity; PR=pregnancy. *=P<0.05; **=P<0.01; ***=P<0.001. a, b, c: P<0.05

The lactating does that were non-lactating in the previous cycle showed a higher frequency at maximum BCS (9.7, 35.5 and 54.8% for BCS 0, 1 and 2) than they were lactating (13.5, 42.7 and 43.8% for BCS 0, 1 and 2) or nulliparous (16.7, 43.7 and 39.6% for BCS 0, 1 and 2), indicating how productive effort in the course of first lactation or two successive lactations contributes to reducing the body reserves of does.

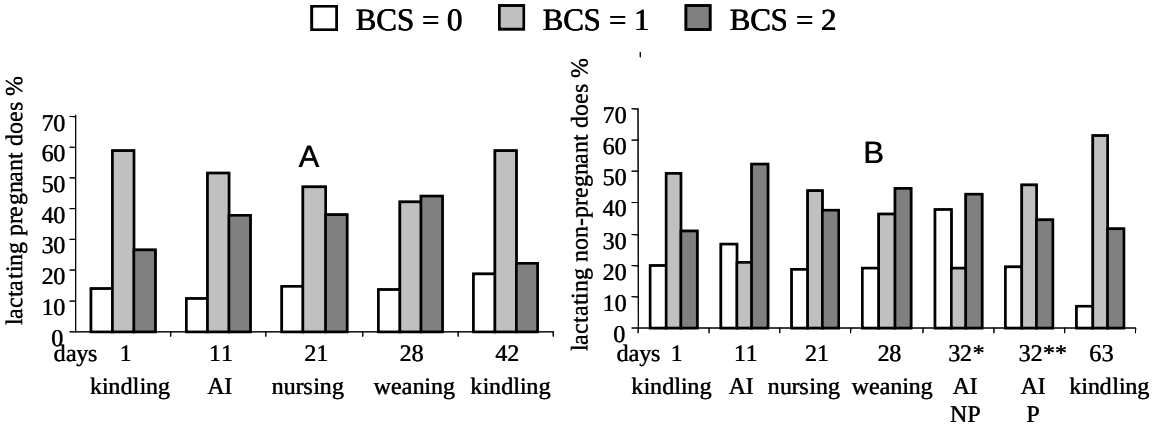

Figure 1: BCS changes during the reproductive cycle of lactating rabbit does when resulted pregnant (A) or non-pregnant (B) at an 11-day AI. *(AI NP)=does resulted non-pregnant at a 32-day AI; **(AI P)=does resulted pregnant at a 32-day AI

Table 2: Effect of body condition score (BCS) of non-pregnant rabbit does re-inseminated when non-lactating at day 32 *post partum* on their reproductive performance and body weight changes (LSM)

	Days pp	BCS			Significant effects (1)	RMSE
		0	1	2		
Inseminations (n)		17	25	25		
Receptivity (%)		74.9	84.1	70.7		39.5
Fertility (%)		53.1 b	84.4 a	64.5 ab	B*	46.0
Total born kits per litter (n)		8.4 b	11.1 a	9.6 ab	B*	2.6
Live-born kits per litter (n)		7.8 b	10.5 a	9.0 ab	B*	2.6
Still-born kits per litter (n)		0.60	0.62	0.57		1.2
Mortality at birth (%)		8.6	6.5	7.7		25.9
Kit weight at birth (g)		76 a	62 b	66 ab	B*	14.2
Doe body weight (g)	11 (AI)	3866 b	4079 a	4176 a	B**, P**	293
	32 (AI)	3788 c	4027 b	4302 a	B***, P*, PxB*	271
	63 (parturition)	3982	4100	4260	P**	329
Doe body weight change (g)	11-32	-99 b	-41 b	87 a	B*	200
	32-63	138	103	-23	PxB**	219

(1) B= BCS; P=parity. *=P<0.05; **=P<0.01; ***=P<0.001. a, b, c: P<0.05

During the reproductive cycle, the lactating does that were pregnant at an 11-day AI (Figure 1A) showed light changes in their frequency at different BCS. From day 1 to 11 pp, the does with BCS 1 were prevalent (59.1 and 51.7%), but from day 1 to 28 pp there was a tendency to an increment in frequency of BCS 2 (from 26.8 to 44.1%), corresponding to a reduction of BCS 1 (from 59.1 to 42.1%). Nevertheless, at successive parturition (day 42), the does returned to a BCS distribution which was similar to that of previous parturition, with a prevalence of does with BCS 1 (58.7%). When lactating does were non-pregnant at an 11-day AI (figure 1B), their frequency in the BCS 2 increased more markedly from day 1 to 11 pp (from 30.8 to 52.2%) than they were pregnant (from 26.8 vs. 37.7%). At successive AI (at day 32 pp), the non-lactating does resulted non-pregnant showed higher incidence at BCS 0 (38.1 vs. 19.6%) and lower at BCS 1 (19.0 vs. 45.7%) if compared with non-lactating does resulted pregnant. Pregnancy allowed this latter to improve BCS from 0 to 1 at parturition. These BCS trends suggest that failures in fertility of lactating does are determined more by their excessive fatness than their poor body condition.

In non lactating does (Table 2), their intermediate BCS at a 32-day AI also led to an improvement in fertility and total born kits per litter. Nevertheless, at intermediate BCS the larger litter size corresponded to a lower kit weight at birth. Body weight changes in the period between the two successive AI (from day 11 to 32 pp) showed a certain stability in the does with BCS 1, whereas the does with poor BCS lost weight and, in contrast, the does with maximum BCS gained weight.

During the experimental period (126 days), the culling rate of does was 25.0%, equally distributed over the time (7.3, 9.4 and 8.3% after first, second and third parturition) and due to infertility (9.4%) or death (15.6%). The main part of does culled for infertility (44.4%) or dead (46.7%) had a BCS equal to 2.

CONCLUSIONS

The simplified 3-point scale method here proposed for *in vivo* scoring body condition may become an effective and rapid tool to predict the fatness status of rabbit does and manage their nutrition and reproductive rhythm. The higher fertility of lactating does inseminated at 11-day pp and non-lactating does re-inseminated at 32 days pp with an intermediate BCS confirms the negative result of a poor or an excessive body fatness. The poor BCS was linked to lower fertility and prolificacy and higher mortality of nursed kits during 1-11 days pp, whereas the high BCS led to lower fertility and higher culling rate of does. The BCS change of non-pregnant lactating does from day 1 to 11 pp occurred mainly towards the maximum value. The lactating does that were non-lactating in the previous cycle increased their incidence at maximum BCS in comparison with twice lactating does. Therefore, the failures in fertility at an 11-day AI and culling rate seem to be here more imputable to the excessive body fatness of rabbit does and less to their poor body condition. In this regard, further investigations are required.

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