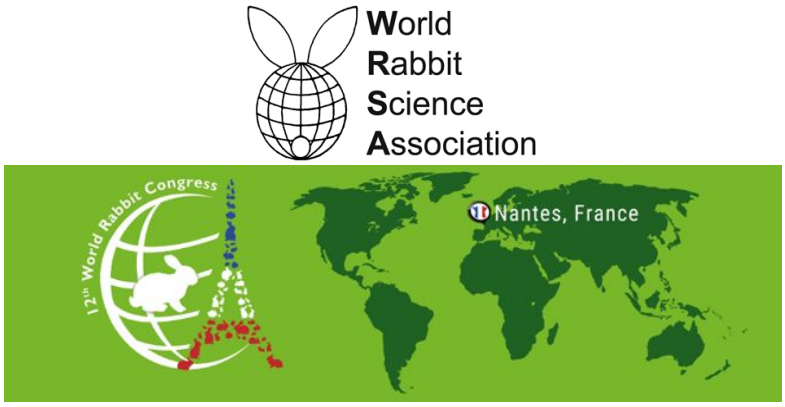


PROCEEDINGS OF THE 12th WORLD RABBIT CONGRESS

Nantes (France) - November 3-5, 2021

ISSN 2308-1910

Session

REPRODUCTION

Eiben Cs., Sándor M., Sándor F., Mohaupt M., Kustos K.

EFFECT OF SHORT FAST-REFEEDING AND LIGHT PROGRAM ON RABBIT DOE REPRODUCTION

Full text of the communication

+

Slides of the oral presentation

How to cite this paper

Eiben Cs., Sándor M., Sándor F., Mohaupt M., Kustos K., 2021. Effect of short fast-refeeding and light program on rabbit doe reproduction. Proceedings 12th World Rabbit Congress - November 3-5 2021 - Nantes, France, Communication R-08, 4 pp. + presentation

EFFECT OF SHORT FAST-REFEEDING AND LIGHT PROGRAM ON RABBIT DOE REPRODUCTION

Eiben Cs.[1]*, Sándor M.[2], Sándor F.[2], Mohaupt M.[2], Kustos K.[3]

[1]National Centre for Biodiversity and Gene Conservation, Isaszegi út 200, H-2100, Gödöllő, Hungary
[2]S&K-Lap Ltd., Császár u. 135, H-2173, Kartal, Hungary
[3]Lab-Nyúl Ltd., Kossuth L. u. 27, H-2100, Gödöllő, Hungary
*Corresponding author: eiben.csilla@hagk.hu

ABSTRACT

The reproduction of 1-14 day controlled nursing rabbits subjected to light stimulation (L) or fast-refeeding plus light stimulation (FL) before AI (on day 11) was compared in two reproduction cycles in winter in Galgamácsa rabbit farm. On day 8 before AI the daily 9 h and 50 lux LED lighting was increased to 16 h and 100 lux that was gradually set back until day 5 after AI. The L rabbits were fed *ad libitum*. As nutritive stimulus, the FL rabbits received the same diet but they had a 24 h water-only fast and 48–50 h *ad libitum* re-feeding before AI. Fast-refeeding plus light stimulation did not further improve doe reproduction. Sexual receptivity, pregnancy and kindling rates of the FL and L does did not differ significantly in the first cycle (FL: 44, 91 and 86%; L: 42, 90 and 85%) nor in the second reproduction cycle (FL: 44, 92 and 89%; L: 51, 91 and 86%). With refeeding plus light stimulation the number of live born kits per litter hardly changed in the first cycle (FL: 9.07 and L: 9.28) but seemed to decrease (P=0.056) in the second cycle (FL: 9.69 and L: 10.2). Compared to the L rabbits (789) the productivity (number of live born kits per 100 AI) of the FL rabbits was similar in the first cycle (784) but 2.0% lower (881 vs 863) in the second cycle. In conclusion, the productivity of light-stimulated rabbits cannot be further increased with fast-refeeding combined with light stimulation.

Key words: Feed restriction, Photostimulation, Controlled nursing, Sexual receptivity, Productivity

INTRODUCTION

In rabbit even a short-term change in nutrient supply can influence doe hormonal status and reproduction (Boiti, 2004; Daoud *et al*., 2012; Menchetti *et al*., 2015). Food deprivation prior to artificial insemination (AI) affects the level of such metabolites and hormones which act as metabolic signal or directly impact receptivity and fertility (Brecchia *et al.*, 2006; García-García *et al.*, 2011; Sirotkin *et al.*, 2014, 2017). Metabolic signals caused by the lack of food can modify the responsiveness of the pituitary to GnRH action, enhancing the gonadotropin release at refeeding (Parillo *et al.*, 2004). Lactation induces anestrus (García-Dalmán and González-Mariscal, 2012). Based on earlier results (Brecchia *et al.*, 2006; Daoud *et al*., 2012; Eiben *et al*., 2008, 2013) the effect of short fast depends on its level, duration, timing, refeeding and the nursing method used. Altered nursing causes a higher activity of a specific brain region (González-Mariscal *et al*., 2015) and affects feed intake (Schuh *et al*., 2005). Lighting influences nursing behavior (Matics *et al*. 2013, 2016) and doe live weight (Sun *et al*., 2017). The change of lighting before AI modifies doe receptivity (Theau-Clément, 2007, 2016; Gerencsér *et al*., 2012; Szendrő *et al.*, 2016; Eiben *et al*., 2016, 2018). Melatonin acts as metabolic signal and indicates the annual reproduction cycle (Cipolla-Neto *et al*., 2014). The energy balance is regulated by the interaction of melatonin and leptin (Buonfiglio *et al.*, 2018) and leptin mediates the effects of melatonin on reproduction (Lv *et al*., 2019).

This work aimed to try the short-term fast with refeeding before AI combined with light program, i.e. increased duration and intensity of lighting before AI as a dual biostimulation not yet studied.

MATERIALS AND METHODS

The trial was conducted at rabbit farm of S&K-Lap Ltd in Galgamácsa. Multiparous Hycole rabbits with litters standardized to ten kits were divided into two groups (L and FL) based on doe live weight at kindling. Artificial insemination (AI) was done on 2 and 23 of January 2015 (1st and 2nd reproduction cycles, n=294 and 294, respectively). Controlled nursing was used by opening the metal-sheet nest door from 9 a.m. to 10 a.m. from postpartum day 1 to 14 and free nursing thereafter.

There was no hormonal oestrus synchronization but from day 8 before AI the duration and intensity of daily lighting were increased in both groups as photostimulation. In the buildings, the dimmable cold-white multichip four-die LED lamps (15x20 cm) provided the daily 9 h and 50 lux basic illumination. On day 8 before AI, the 9 h L (8 a.m. to 5 p.m.) was increased by 7 hours to 16 h L (6 a.m. to 10 p.m.). The lighting was reduced by 2 hours on days 3 and 4 after AI (14L, 6 a.m. to 8 p.m. and 12L, 8 a.m. to 8 p.m.) and by 3 hours on day 5 after AI, returning to the 9 h (8 a.m. to 5 p.m.) daily lighting. To increase light intensity, the LEDs were set to 100 lux from day 8 before AI to day 3 after AI. On day 4 after AI the light intensity was reduced to 80-90 lux and then back to 50 lux.

Rabbits were fed the same diet (10.0 MJ/Kg DE, 17.5% CP, 3.80% EE, 14.9% CF, 7.7% ash) and it was *ad libitum* in only-light stimulated group (L). In group stimulated with fast-refeeding plus lighting (FL) the does were subjected to a 24 h water-only fast between days 8 and 9 and a 48-50 h *ad libitum* re-feeding before AI. In our earlier studies (Eiben *et al.*, 2008, 2013) the feeder was removed (total fast). Now the automatic feeder was closed at Monday night. At 8 a.m. on Tuesday morning about 380-400 g feed remained in the collective feeder supplying four does. The feeder was reopened at 2 p.m. on Wednesday and thereafter there was *ad libitum* feeding (AI on Friday between 10 and 12 a.m.).

AI was done on postpartum day 11 with heterospermic pooled semen from Hycole bucks (0.5 mL/doe) within three hours after nursing. Two-third of rabbit does were induced to ovulate by i.m. administration of 0.2 mL GnRH analogue (Receptal®, 0.84 µg buserelin acetate/doe) and one-third by intravaginal via 0.5 mL semen extender (MRAbit®, 25 µg GnRH analogue [des-Gly10, D-Ala6]-LHRH ethyl amid/doe). To access the effect of GnRH treatment was not aimed here. At AI does with red / violet and turgid vulvas were judged to be receptive. Pregnancy was checked on day 14 after AI by abdominal palpation. In air conditioned (18-20°C) building the rabbits were housed in wire-net breeding cages (80 x 53 cm with 90 cm height) equipped with a plastic mat, an elevated platform (40 x 53 cm) at 25 cm height, a gnawing stick and an outer nest (23 x 53 cm) with metal sheet walls.

The effects of light program or fast-refeeding plus light program on receptivity, pregnancy and kindling rates were evaluated by the chi-squared test and on the number of kits born by ANOVA using the Statgraphics 6.0 (1992) statistical software. Productivity was calculated as the number of live born kits per 100 AI.

RESULTS AND DISCUSSION

With fast-refeeding plus light program (FL) the ratio of rabbits with red vulva seemed to decrease only at the 2nd reproductive cycle. In FL rabbits, the occurrence of white vulva seemed to increase while violet to decrease (Figure 1, P>0.05). The proportion of FL rabbits with turgid vulva was slightly lower than in merely light stimulated L rabbits (Table 1, P>0.05). This trend was observed by Gómez *et al.* (2004) with 24 h fasting without refeeding in nulliparous rabbits where the ratio of rabbits having white vulva increased and those with red vulva decreased.

The ”dual” stimulation decreased the visual signs of sexual receptivity but pregnancy and kindling rates seemed to improve (Table 1). In the study of Daoud *et al.* (2012) feed restriction with refeeding increased the number of quality oocytes and GDF-9 gene expression responsible for fertility supporting our results. The total born kits per litter was the highest in L rabbits at the 2nd reproductive cycle when the best receptivity was found. However, the number of live born kits per litter seemed to

decrease at the 2nd reproductive cycle in FL rabbits (9.69 vs 10.2; P=0.056, Table 1). The "dual" stimulation could impair prenatal life. Feeding can affect embryonic development (Lorenzo *et al*., 2014; Naturil-Alfonso *et al*., 2016, 2017). Feed restriction can alter the sensitivity to hormones and hormonal effects (Harrath *et al*, 2017; Sirotkin *et al*., 2017). The productivity with only light program was 2% better at the 2nd reproductive cycle than with the fast plus light program (881 vs 863 rabbits, Table 1). In this cycle the kindling rate of the FL rabbits was vainly 3% higher, because of the less number of live born kits, the productivity reduced.

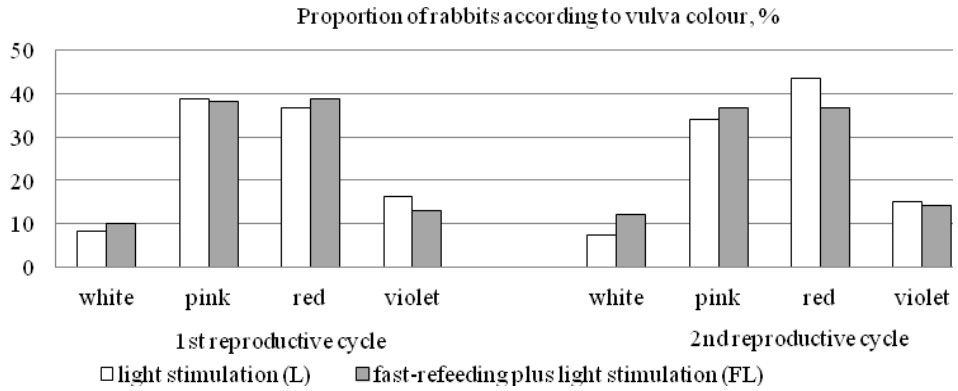


Figure 1: Effect of light program (L) or fast-refeeding plus light program (FL) on vulva colour

Table 1: Effect of light stimulation (L) or fast-refeeding plus light stimulation (FL) on reproduction

	1st reproduction cycle			2nd reproduction cycle		
Groups	L	FL	Prob.	L	FL	Prob.
	n=147	n=147		n=147	n=147	
Red-violet vulva, %	53.1	51.7	NS	58.5	51.0	NS
Turgid vulva, %	59.9	57.1	NS	65.3	56.5	NS
Sexual receptivity, %	42.2	44.2	NS	51.0	44.2	NS
Pregnancy rate, %	89.9	90.5	NS	90.5	91.8	NS
Kindling rate, %	85.0	86.4	NS	86.4	89.1	NS
No. of born kits per litter	10.8±0.2	10.6±0.2	NS	11.2±0.2	11.1±0.2	NS
No. of live born kits	9.28±0.2	9.07±0.2	NS	10.2±0.2	9.69±0.2	0.056
Productivity	789	784	-	881	863	-

NS: P>0.05

CONCLUSIONS

The productivity of light-stimulated rabbits cannot be further increased with fast-refeeding combined with light stimulation.

ACKNOWLEDGEMENTS

This study was supported by KMR_12-1-2012-0195 grant.

REFERENCES

Boiti C., 2004. Underlying physiological mechanisms controlling the reproductive axis of rabbit does. *In: Proc. 8th World Rabbit Congress, 2004 September, Puebla, Mexico, 186-206*.

Brecchia G., Bonanno A., Galeati G., Federici C., Maranesi M., Gobbetti A., Zerani M., Boiti C., 2006. Hormonal and metabolic adaptation to fasting: effects on the hypothalamic- pituitary-ovarian axis and reproductive performance of rabbit does. *Domest. Anim. Endocrinol., 31, 105-122.*

Buonfiglio D., Parthimos R., Dantas R., Cerqueira Silva R., Gomes G., Andrade-Silva. J, Ramos-Lobo A., Amaral F.G., Matos R., Sinésio J. Jr., Motta-Teixeira L.C., Donato J. Jr., Reiter R.J., Cipolla-Neto J., 2018. Melatonin Absence Leads to Long-Term Leptin Resistance and Overweight in Rats. *Front. Endocrinol., 9:122. doi: 10.3389/fendo.2018.00122*

Cipolla-Neto J., Amaral F.G., Afeche S.C., Tan D.X., Reiter R.J., 2014. Melatonin, energy metabolism, and obesity: a review. *J. Pineal Res., 56, 371-381*.

Daoud N.M, Mahrous K.F., Ezzo O.H., 2012. Feed restriction as a biostimulant of the production of oocyte, their quality and GDF-9 gene expression in rabbit oocytes. *Anim. Reprod. Sci., 136, 121-127*.

Eiben Cs., Bonanno A., Gódor-Surmann K., Kustos K., 2008. Effect of controlled nursing with one-day fasting on rabbit doe performance. *Livest.Sci.118, 82-91*.

Eiben Cs., Gódor-Surmann K., Kustos K., 2013. Effect of a transitory controlled nursing on days 9–11 or a 24-h fast on the production of free-nursing rabbits. *Livest.Sci.155, 148-156*.

Eiben Cs., Sándor M., Sándor F., Kustos K., 2016. Effect of photostimulation, light source and season on reproductive performance of rabbit does. *In*: *Proc. 11th World Rabbit Congress. 2016 June, Qingdao, China, 189-192*.

Eiben Cs., Sándor M., Sándor F. Mohaupt M., Kustos K., 2018. Effect of doe–litter separation and photostimulation on reproductive performance of rabbit does. *In: Proc. 30th Hungarian Conference on Rabbit Production, 2018 May, Kaposvár, Hungary, 67-73*.

García-Dalmán C., González-Mariscal G., 2012. Major role of suckling stimulation for inhibition of estrous behaviors in lactating rabbits: Acute and chronic effects. *Horm. Behav. 61, 108-113*.

García-García R.M., Rebollar P.G., Arias-Álvarez M., Sakr O.G., Bermejo-Álvarez P., Brecchia G., Gutierrez-Adan A., Zerani M., Boiti C., Lorenzo P.L., 2011. Acute fasting before conception affects metabolic and endocrine status without impacting follicle and oocyte development and embryo gene expression in the rabbit. *Reprod. Fertil. Dev., 23, 759-68*.

Gerencsér Zs., Matics, Zs. Nagy I., Radnai I., Szendrő É,. Szendrő Zs., 2012. Effect of lighting programme and nursing method on the production and nursing behaviour of rabbit does. *World Rabbit Sci., 20 (2), 103-116*.

Gómez R.B.,, Becerril P.C.M., Torres H.G., Pro M.A., Rodríguez De Lara R., 2004. Relationship among feeding level, change of cage and fasting with vulva color and sexual receptivity in New Zealand White and Californian nulliparous does. *In: Proc. 8th World Rabbit Congress, 2004 September, Puebla, Mexico, 270-275*.

González-Mariscal G., García-Dalmán C., Jiménez A., 2015. Biostimulation and nursing modify mating-induced c-FOS immunoreactivity in the female rabbit forebrain. *Brain Research, 1608, 66-74*.

Harrath A.H., Østrup O., Rafay J., Koničková (Floroničková) I, Laurincik J., Sirotkin A.V., 2017. Metabolic state defines the response of rabbit ovary cells to leptin. *Reproductive Biology, 17, 19-24*.

Lorenzo P.L., García-García R.M., Arias-Álvarez M., Rebollar P.G., 2014. Reproductive and nutritional management on ovarian response and embryo quality on rabbit does. *Reprod. Dom. Anim., 49 (Suppl. 4) 49-55*.

Lv D., Tan T., Zhu T., Wang J., Zhang S., Zhang L., Hu X., Liu G., Xing Y., 2019. Leptin mediates the effects of melatonin on female reproduction in mammals. *J Pineal Res, 66:e12559. https://doi.org/10.1111/jpi.12559*

Matics Zs., Gerencsér Zs., Radnai I., Dalle-Zolle A., Palumbo M., Mikó A., Kasza R., Szendrő Zs., 2013. Effect of different lighting schedules (16L:8D or 12L:6D) on reproductive performance and nursing behaviour of rabbit does. *Livest Sci., 157, 545-551*.

Matics Zs., Szendrő Zs., Radnai I., Kasza R., Gerencsér Zs., 2016. Effect of light intensities on reproductive performance, nursing behaviour and preference of rabbit does. *World Rabbit Sci., 24 (2), 139-144*.

Menchetti M., Brecchia G., Canali C., Cardinali R., Polisca A., Zerani M., Boiti C., 2015. Food restriction during pregnancy in rabbits: Effects on hormones and metabolites involved in energy homeostasis and metabolic programming. *Res. Vet. Sci., 98, 7-12*.

Naturil-Alfonso C., Lavara R., Vicente J.S., Marco-Jiménez F., 2016. Effects of female dietary restriction in a rabbit growth line during rearing on reproductive performance and embryo quality. *Reprod. Dom. Anim., 51, 114-122*.

Naturil-Alfonso C., Peñaranda D.S., Vicente J.S., Marco-Jiménez F., 2017. Feed restriction regime in a rabbit line selected for growth rate alters oocyte maturation manifested by alteration in *MSY2* gene expression. *Reprod. Dom. Anim., 1-9*.

Parillo F., Zerani M., Maranesi M., Dall'Aglio C., Galeati G., Brecchia G., Boiti C., González-Mariscal G., 2014. Ovarian hormones and fasting differentially regulate pituitary receptors for estrogen and gonadotropin-releasing hormone in rabbit female. *Microsc. Res. Tech., 77 (3), 201-210*.

Schuh D., Hoy St., Selzer D., 2005. Einfluss einer zeitweiligen Mutter-Wurf-Separierung auf das Verhalten der Häsin. *In*: *Proc. 14. Arbeitstagung über Haltung und Krankheiten der Kaninchen, Pelztiere und Heimtiere*. Celle, Germany, 47-51.

Sirotkin A.V., Chrenek P., Kolesarová A., Parillo F., Zerani M., Boiti C., 2014. Novel regulators of rabbit reproductive functions. *Anim. Reprod. Sci., 148, 188- 96*.

Sirotkin A.V., Koničková (Floroničková) I, Østrup (Švarcová) O., Rafay J., Laurincik J., Harrath A.H., 2017. Caloric restriction and IGF-I administration promote rabbit fecundity: Possible interrelationship and mechanisms of action. *Theriogenology, 90, 252-259*.

Statgraphics ® 1992. Reference Manual, Version 6.0, *Manugistics Inc., Rockville, MD, USA*

Sun L., Wu Z., Li F., Liu L., Li J., Zhang D., Sun C., 2017. Effect of light intensity on ovarian gene expression, reproductive performance and body weight of rabbit does. *Anim. Reprod. Sci., 183, 118-125*.

Szendrő Zs., Gerencsér Zs., McNitt J.I., Matics Zs., 2016. Effect of lighting on rabbits and its role in rabbit production: A review. *Livest. Sci., 183, 12-18*.

Theau-Clément M., 2007. Preparation of the rabbit doe to insemination: a review. *World Rabbit Sci., 15 (2), 61-68*.

Theau-Clément M., Guardia S., Davoust C., Galliot P., Souchet C., Bignon L., Fortun-Lamothe L., 2016. Performance and sustainability of two alternative rabbit breeding systems. *World Rabbit Sci., 24 (4), 253-265*.

Effect of short fast-refeeding and light program on rabbit doe reproduction

Eiben Cs*., Sándor M., Sándor F., Mohaupt M., Kustos K.

*National Centre for Biodiversity and Gene Conservation

Gödöllő, Hungary

S&K-Lap Ltd.

Kartal, Hungary

Oestrus synchronization before AI

Hormonal (eCG) treatment

No hormonal treatment (biostimulation)

Light Program ✓

+ 

Doe-Litter Separation + Light Program ✓

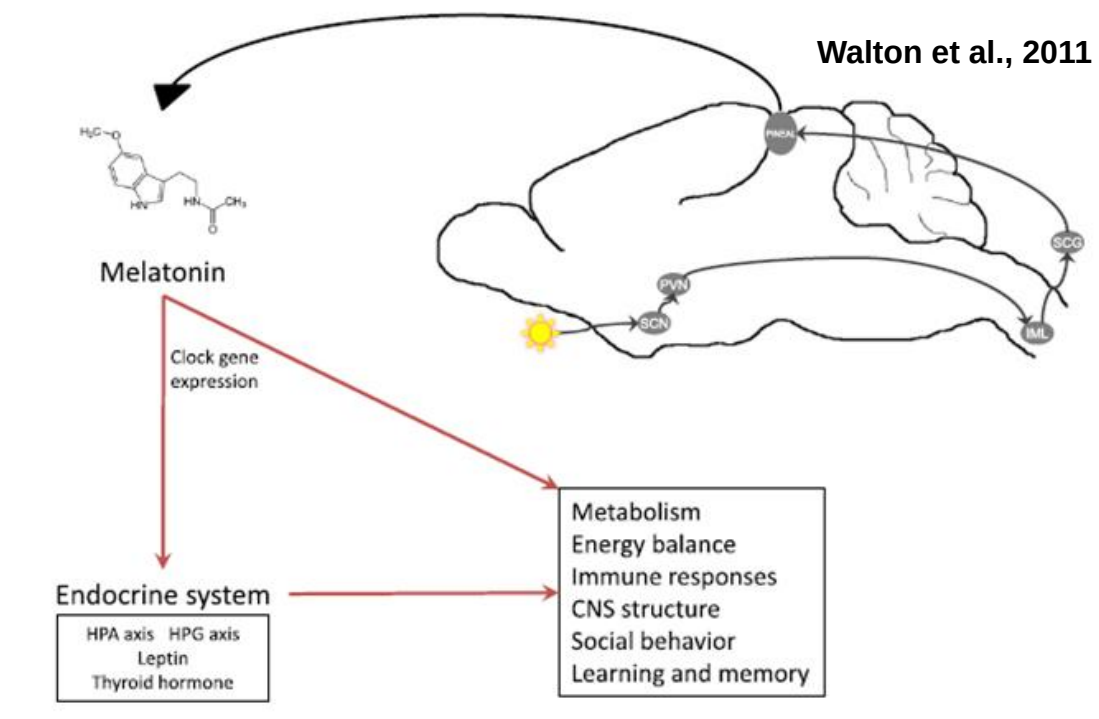
+ 

Fast-Refeeding + Light Program ?

Nursing
Lighting
Feeding

Neuro-Hormonal Effects →

Reproduction
Feed Intake
Milk Yield
Doe/Kit Behaviour



Next Kindling

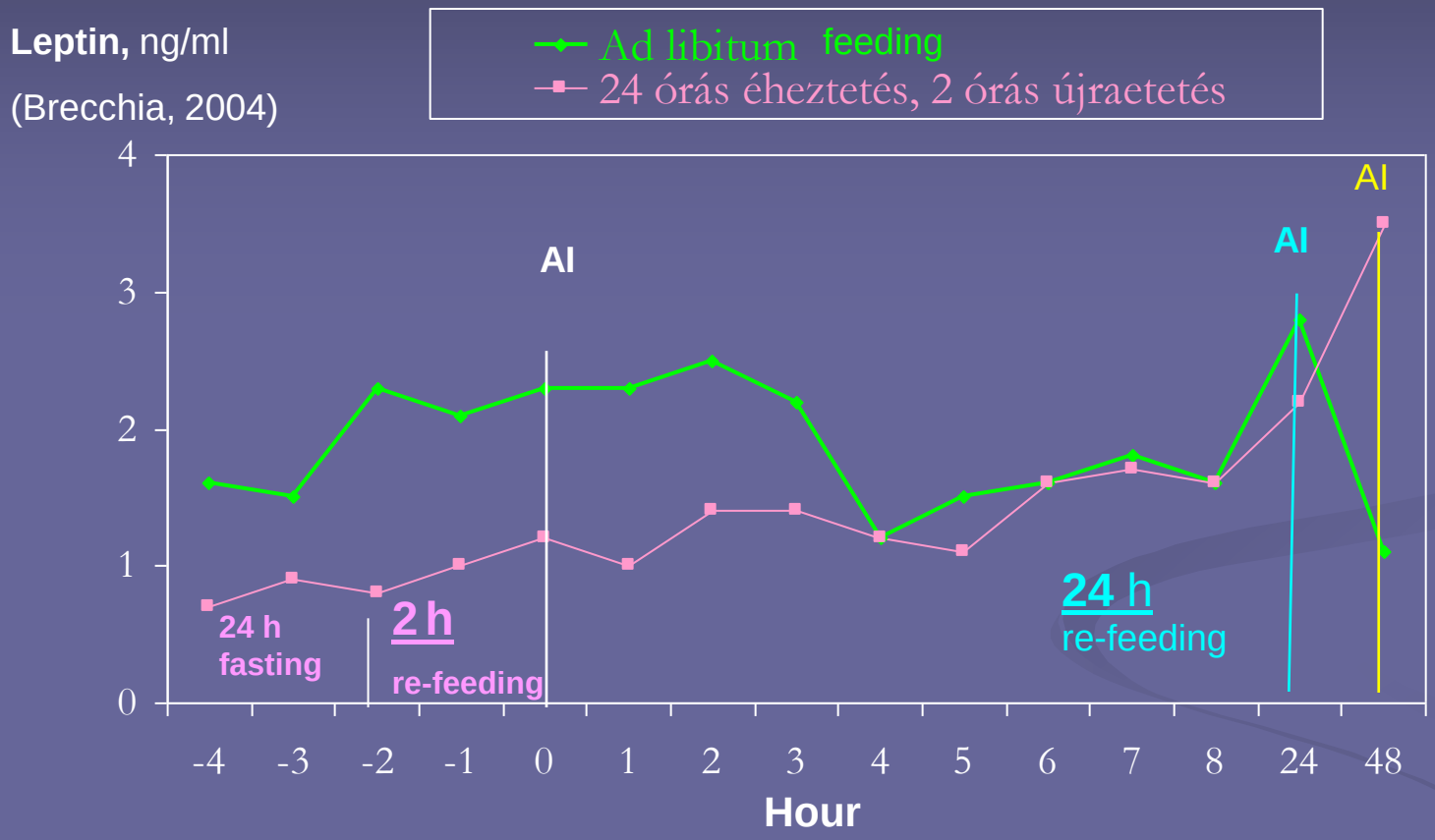
Reared Litter

Light Program: Increased Duration and Intensity of LED Lighting before AI

Aim: Fast-Refeeding plus Light Program as Biostimulation?

TIMING of FASTING

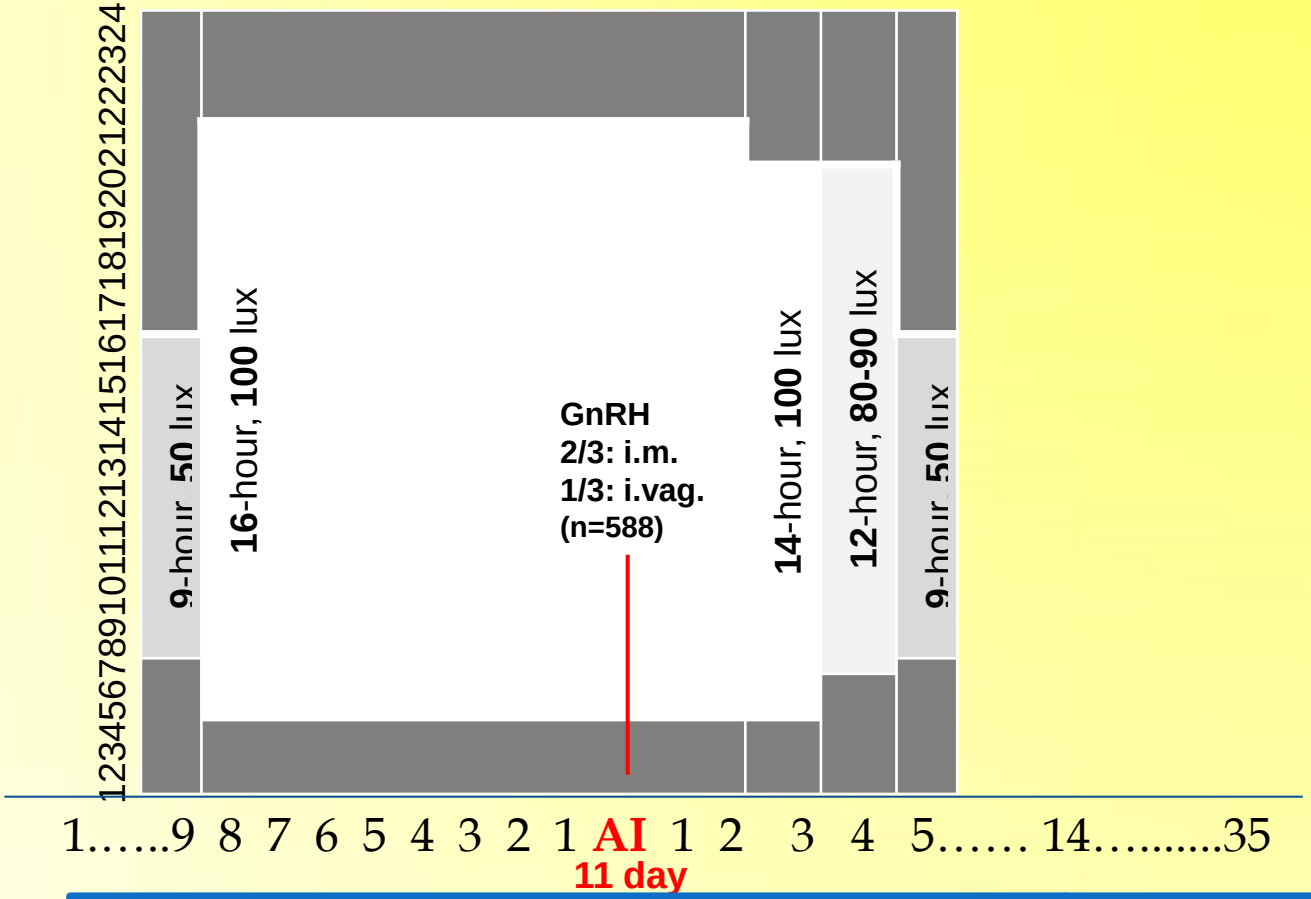
Leptin and Reproduction



48-50 h
Re-feeding

	Brecchia (2004)		**Bonanno (2004)**		**Eiben (2008, 2013)**	
	Nursing: free		free		restricted	free
Fertility:	43%	< 59%	59%	> 53%	82% > 74%	71% = 72%
Kits born alive:	6.6	< 7.7	8.8	> 7.9	9.8 > 9.5	6.8 < 7.9

Light Program: Increased Duration and Intensity of LED Lighting before AI



Groups:

Light program (L): Only Light Stimulation, ad libitum Feeding

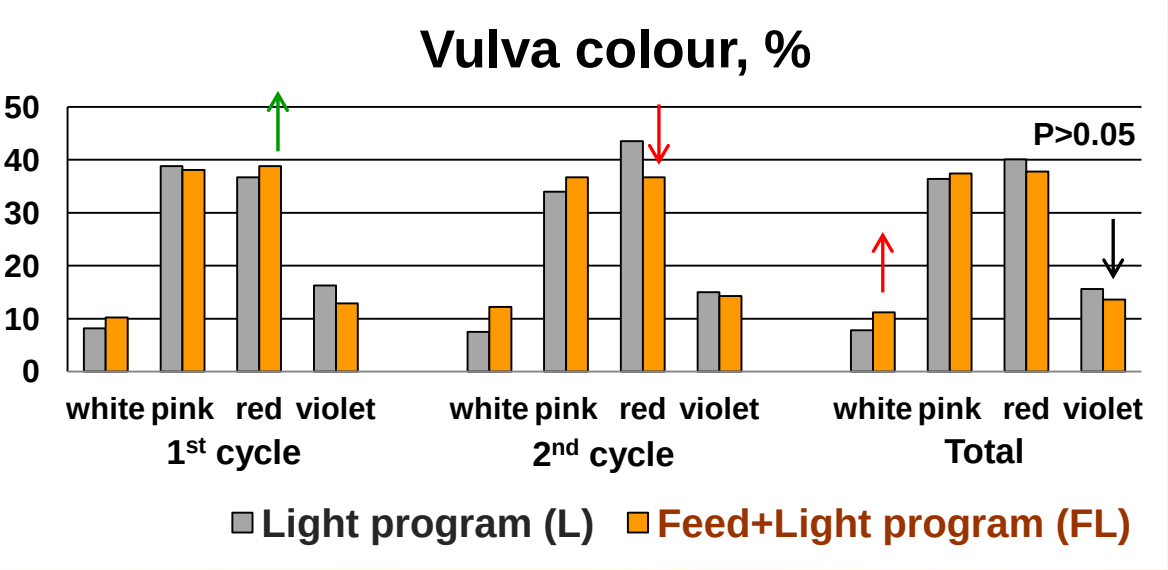
Feed +Light Program (FL):

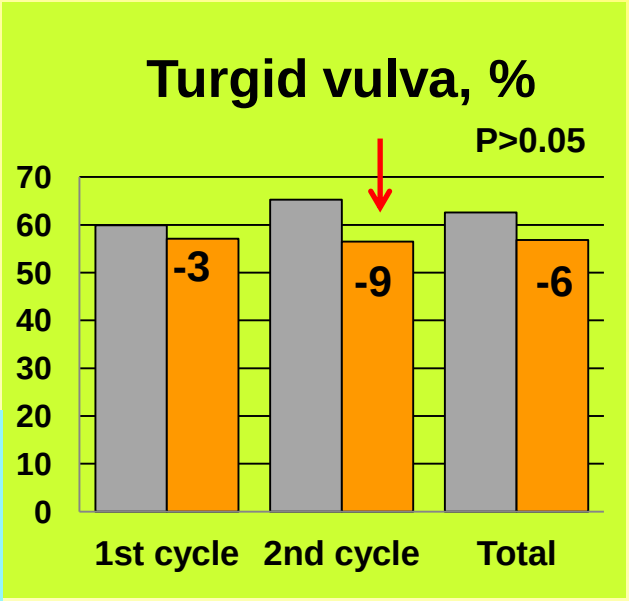
24 h 48-50 h

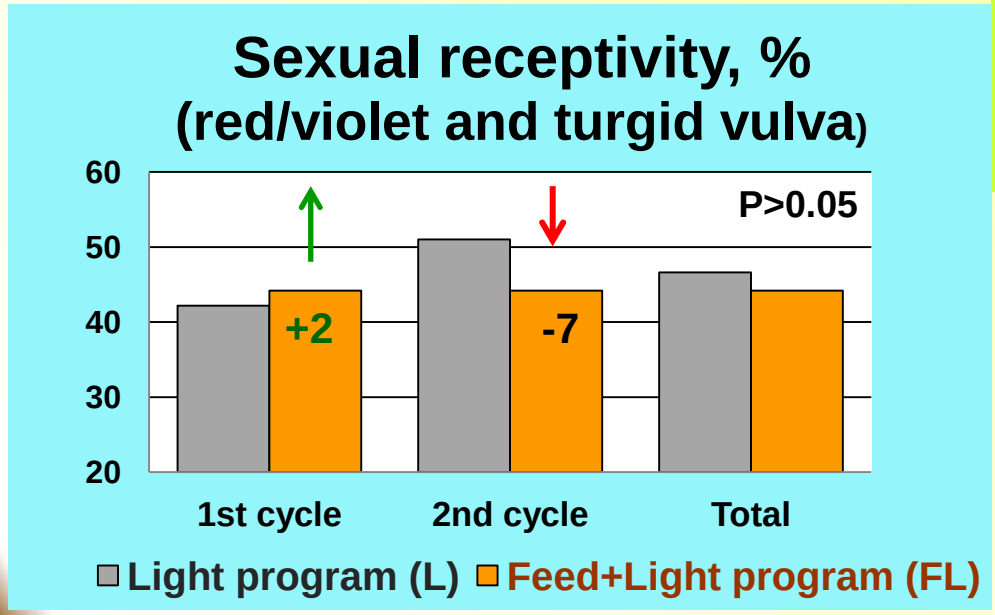
FAST

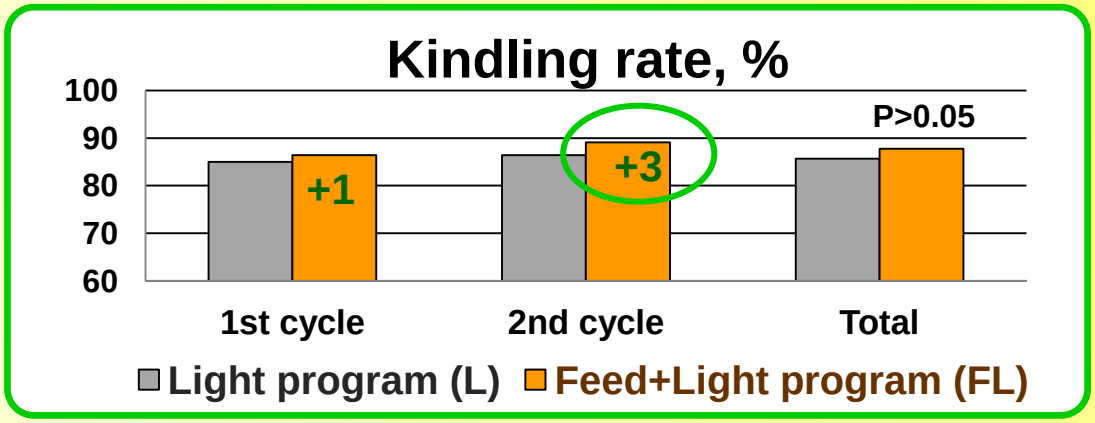
Ad lib re-feeding before AI

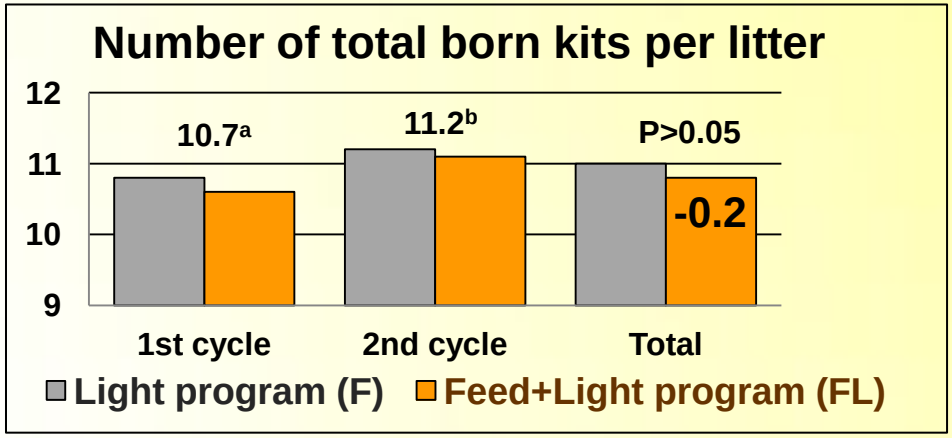
Sexual Receptivity

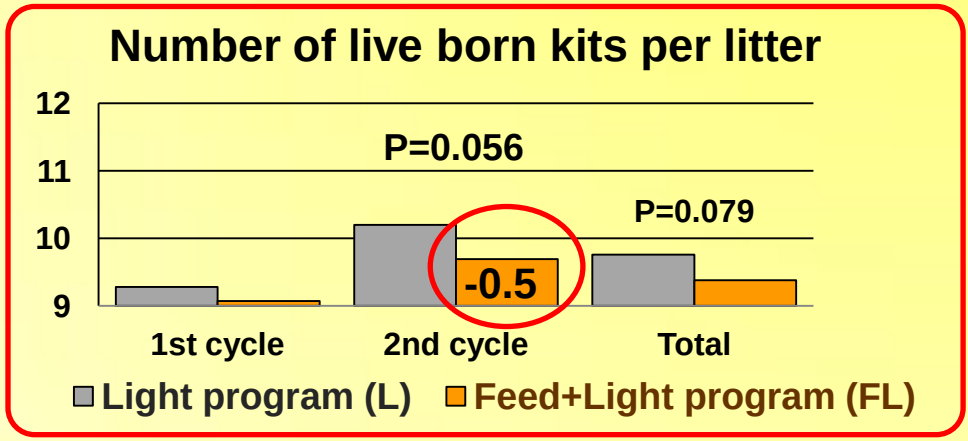


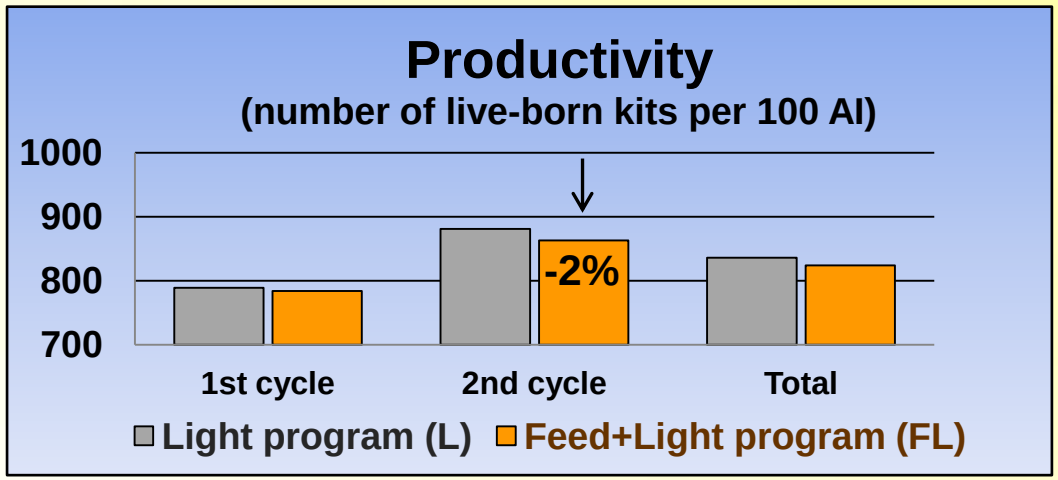





Kindling rate, %
100
90
80
70
60
+1
+3
P>0.05
1st cycle
2nd cycle
Total
Light program (L)
Feed+Light program (FL)


Number of total born kits per litter
12
11
10
9
10.7a
11.2b
P>0.05
-0.2
1st cycle
2nd cycle
Total
Light program (F)
Feed+Light program (FL)


Number of live born kits per litter
12
11
10
9
P=0.056
P=0.079
-0.5
1st cycle
2nd cycle
Total
Light program (L)
Feed+Light program (FL)


Productivity
(number of live-born kits per 100 AI)
1000
900
800
700
-2%
1st cycle
2nd cycle
Total
Light program (L)
Feed+Light program (FL)

Conclusions

The **productivity** of **light-stimulated** **rabbits** **cannot be** further **increased** **with fast-refeeding combined with light stimulation**.

Thank you for your attention!