INFLUENCE OF FEEDING LEVEL ON FSH AND LH SECRETION PATTERNS DURING LACTATION, ON UTERUS AND FOLLICLE DEVELOPMENT AFTER WEANING IN SOWS

UTJECAJ RAZINE HRANIDBE NA SEKRECIJU FSH I LH ZA VRIJEME LAKTACIJE TE NA RAZVOJ FOLIKULA U KRMAČA NAKON ODBIĆA

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SUMMARY

Feeding during lactation has been shown to effect physiology of reproduction in sows. A study was conducted to define the hormonal patterns of FSH and LH in lactation (21 days), the development of uterus and follicles after weaning in primiparous sows fed restricted (RE) or ad libitum (AL).

14 sows were used; 7 in each group AL and in group RE (≈70% of the diet of AL-sows). An intravenous catheter was inserted on day 6/7 post partum (pp). Blood samples were collected on days 12, 15 and 18 pp. FSH and LH were analysed by RIA. Daily ultrasonography of the ovaries between day 8 and 20/21 pp was used on a few animals per group to monitor follicular growth. All sows were slaughtered either 1 or 7 days after weaning. Mean daily feed intake during lactation was 3.9 kg in AL- and 2.7 kg in RE-sows. FSH concentrations were similar in AL- and RE-sows on day 12 pp, but higher in AL-sows on day 15 and day 18 pp ($P<0,05$). Generally LH concentrations were higher in AL- than in RE-sows ($P<0.05$). The results demonstrate that lactating AL-sows had higher both LH and FSH concentrations during lactation than RE-sows. An association to simultaneously observed differences in follicular growth is assumed. The weights of uterus were higher 24 hours and 7 days after weaning, in AL-sows (399/478g) than in RE-sows (335/392g). Generally the follicular status of AL-sows was more developed than in RE-sows.

Key words: feeding, sows, lactation, follicle development

INTRODUCTION

Numerous papers in the literature confirm the high influence of nutrition on features of reproduction in pigs (Whittemore et al., 1995; Kirchgessner, 1997). Generally the nutrition level during pregnancy and lactation effect the following reproduction cycle (Mullan and Williams, 1989; Weldon et al. 1994). It is well-known: that the body fat has an important effect on reproduction physiology. It depends on the feeding level strongly. The fat tissue is the main

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place for storage of 17ß-estrogen (Wähner et al. 1993a, b). There are strong effects on ovary activity during proestrus und estrus and following the reproduction performance (Wähner et al., 1995; Hühn, 1997; Kämmerer et al. 1998). Owing to this lactation is a very sensitive time in the reproductive cycle. During this period the uterus and ovaries have to regenerate (Schnurrbusch and Hühn, 1994). This process requires about 3 weeks. A few exogenous influences stimulate regeneration of the reproductive organs, others delay the process. A short regeneration period without disturbances promotes short weaning to oestrus intervals. Follicular development is the main prerequisite for ensuring the onset of oestrus in weaned sows. There is a direct relation between feeding level in first days of lactation and endocrinological traits and start of ovary activity (Miller et al., 1996; Cox, 1997). At day 14 of lactation in comparison with ad libitum fed sows in restricted fed sows the pulses of LH-secretion and the relation of sows with ovarian activities and the number of follicles of 3mm diameter per sow were reduced. Additionally restricted fed sows have a longer weaning-estrus interval than ad libitum fed sows (Varley and Foxcroft, 1990; Hühn, 1997; John and Wähner, 1999).

The objective of the experiment was to investigate the natural response at various times after weaning resulting from different nutrition involving various energy intake levels over a 3 week lactation period.

The development of the uterus and follicles after weaning was analyzed. Feeding during lactation has been shown to effect rearing performance, endocrinology and physiology of reproduction in sows (e.g. LH, Insulin, Leptin, IGF). Studies focussing on FSH are rare. The study was conducted to define the hormonal patterns of both FSH and LH gonadotrophins in primiparous sows fed restricted or *ad libitum*.

MATERIAL AND METHODS

14 primiparous sows were included in two experiments and divided into two groups. The difference between the two was the feed ration:

- Group 1 (AL): 7 sows were given an *ad libitum* ration with energy concentration of 14.6 MJ/kg dry matter

- Group 2 (RE): 7 sows were fed a ration set at 70 % of the feed level of the AL-sows

In RE-sows, the feed ration was calculated using the mean feed intake of the AL-sows on the previous day. The duration of lactation was generally 21 days.

For collection of blood samples for hormone analyses an intravenous catheter was inserted on day 6/7 post partum (PP). Blood sampling was carried out on days 12, 15 and 18 pp. Every 15 minutes starting at 7.00 am for 11 hours. FSH and LH were analyzed by RIA.

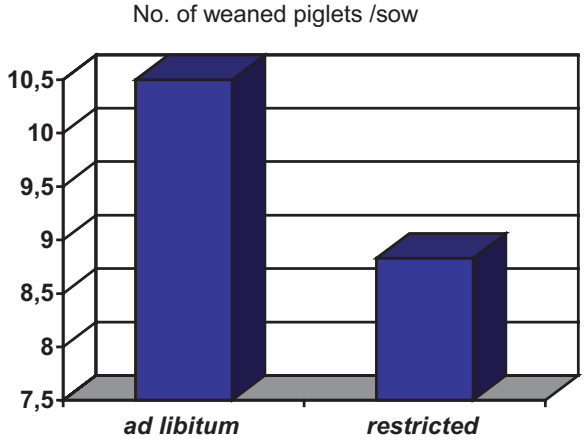
Daily the ovaries between day 8 and 20/21 pp on a few animals per group were checked to monitor follicular growth. All sows were slaughtered after weaning. 5 sows were slaughtered at 24 hours and 9 sows were slaughtered 7 days after weaning. After slaughter the genital organs (ovaries and uterus) were removed from the carcasses. The ovaries, follicles and uteri were examined and uterine and follicular development was registered at these times.

RESULTS

Uterine and follicular development

The mean daily feed intake during lactation was 3.9 kg in AL- and 2.7 kg in RE-sows.

The rearing performance of ad libitum fed sows was significantly higher than that of restricted fed sows (pic. 1).



Picture 1. Number of piglets weaned from primiparous sows fed ad libitum or restricted

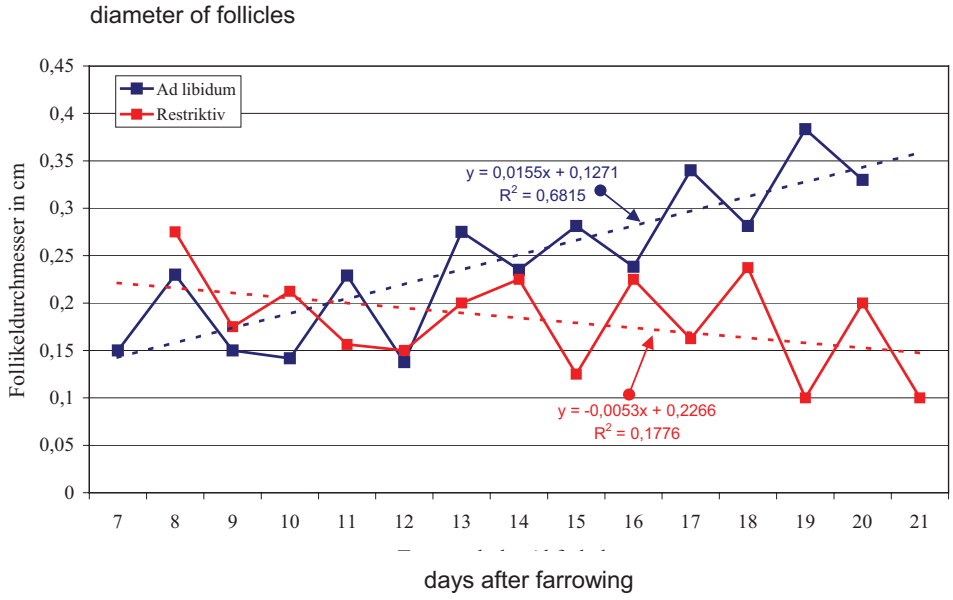
Table 1. Influence of energy intake during lactation on development of the genitalia in weaned sows

Timing of the examination	n	Weight of uterus (g)		Length of uterus (cm)		Ovaries
		x	s	x	s	
Sows fed ad libitum						
24 hours after weaning	3	399	90	98	10,4	Tertiary follicles with diameter 3-6 mm
7 days after weaning	5	478	154			15,4 ± 2,3 Graafian follicles & Corp. haemorrhagica
Sows fed restricted						
24 hours after weaning	2	355	175	109	15,0	Tertiary follicles with diameter 3-4 mm
7 days after weaning	6	392	69			13,8 ± 3,3 Corp. haemorrhagica

In comparison to the ad libitum ration, the development of the uterus and ovaries in weaned sows was delayed by the restricted nutrition. The following results were observed (table 1).

In sows fed ad libitum (AL) the uterine weight was 399 g 24 hours after weaning. All sows exhibited follicles of 3-6 mm diameter. 7 days after weaning the weight of uterus was 478 g. In sows with restricted feeding (RE) the uterine weight was 335 g 24 hours after weaning. 7 days after weaning the weight of uterus was 392 g.

In sows following ad libitum feeding (AL) the weight of both ovaries was higher than in sows that only received the restricted feed (RE). Follicular growth on the ovaries was also reduced by restricted feeding (picture 2).



Picture 2. Development of follicles in lactating primiparous sows fed restricted or ad libitum The diameter of follicles of AL-sows increased (r = 0.83) and decreased in RE-sows (r = -0.42)

The following results could be observed. The diameter of the follicles in lactating AL-sows had increased. The correlation was r = 0.83. The diameter of the follicles in lactating RE-sows had decreased. The correlation was r = - 0.42.

In group AL-sows 24 hours after weaning numerous follicles of 3-5 mm in diameter were registered in all animals. 7 days after weaning the average ovulation rate was 15.4 follicles. In 4 of 5 sows ovulation was complete.

In group RE-sows 24 hours after weaning only small follicles of 1 – 2 mm in diameter could be registered in all sows. 7 days after weaning the average ovulation rate was 13.8 follicles. During this time ovulation was also completed in all sows, but mostly only a short time previously.

The results show that in sows with a short lactation period energy intake is very important for the development of uterine and follicular growth.

FSH and LH secretion patterns

FSH concentrations were similar in AL- and RE-sows on day 12 pp, but higher in AL-sows on days 15 and 18 pp. The difference is significant (table 2).

In figure 3 the variance in FSH secretion patterns is shown. A clear effect of nutrition level during lactation on FSH-secretion patterns can be seen there. On day 15 pp the FSH secretion patterns were almost concurring in AL- and RE-sows. A differentiation began on day 15 pp. On day 18 there was a difference between the animals of both groups. With the progression of lactation an increased activity of the pituitary and a subsequent increase in the FSH concentration can be observed in the blood.

LH concentrations were significantly higher in AL- than in RE-sows at all three bleeding intervals. This applies to mean LH, basal-LH number of pulses and LH pulse magnitude (table 3).

Table 2. FSH secretion patterns[1] of sows fed ad libitum (n=5) or restricted (n=5) on different days of lactation

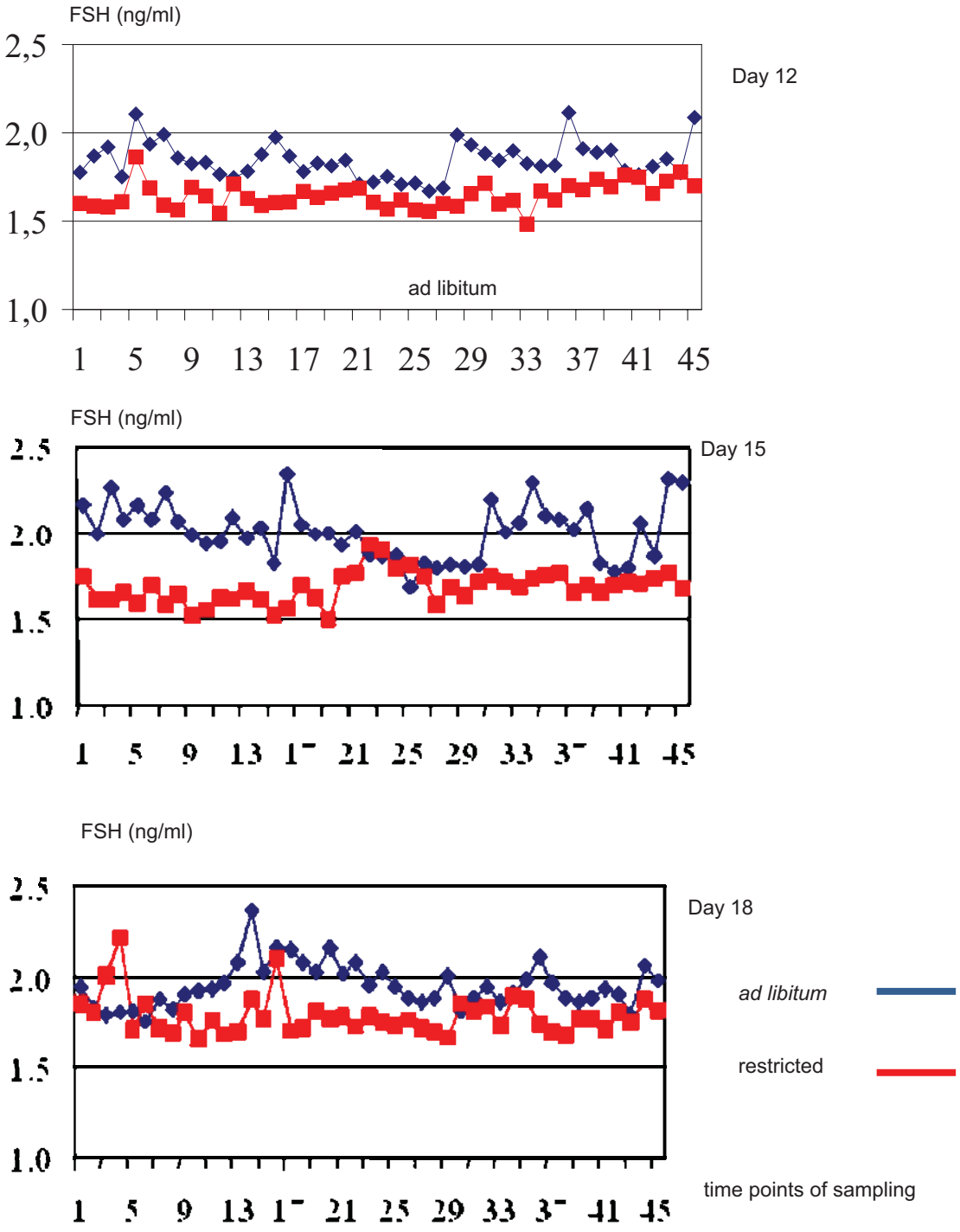
Group	Day post partum (±1day)		
	12	15	18
Ad libitum (AL) (ng/ml)	5,37±0,07^{B}	5,42±0,09$^{a\ B}$	5,99±0,07$^{a\ A}$
Restricted (RE) (ng/ml)	5,19±0,09^{A}	4,71±0,08$^{b\ B}$	4,81±0,12$^{b\ B}$

Values are given as mean ± SE.
[1]Blood samples were taken every 15 min for 11 h on days 12, 15 and 18 post partum (1 ± day). Values with different superscripts differ significantly with a column (a.b) and row (A.B) for the respective parameter.

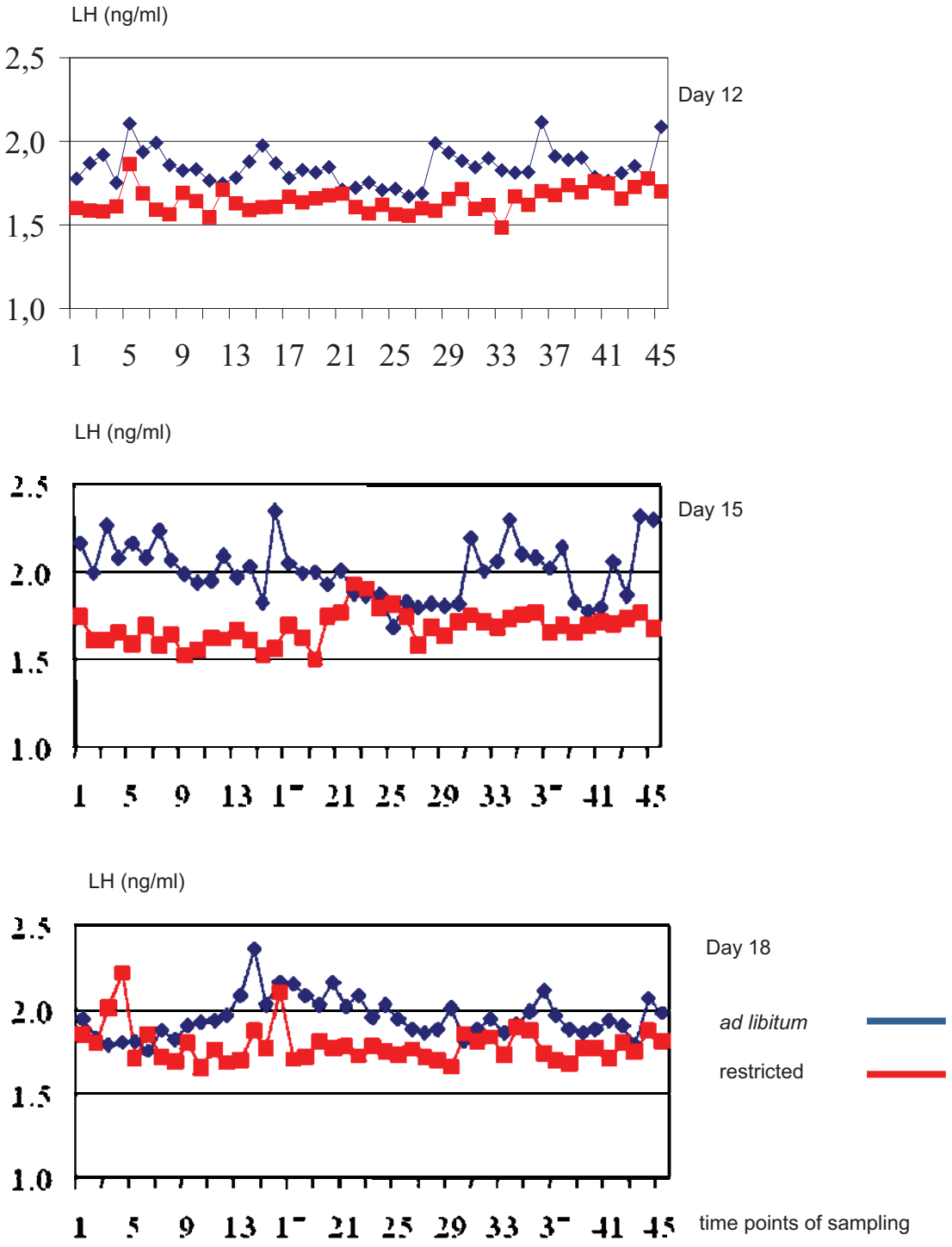
Table 3. LH secretion patterns[1] of sows fed ad libitum (n=5) and restricted (n=5) on different days of lactation

Parameter	Group	Days post partum (±1day)		
		12	15	18
Mean LH (ng/ml)	*ad libitum*	1,86 ± 0,02$^{a\ A\ B}$	1,94 ± 0,03$^{a\ A}$	1,83 ± 0,03^{B}
	restricted	1,65 ± 0,02$^{b\ B}$	1,68 ± 0,02$^{b\ B}$	1,79 ± 0,02^{A}
Basal LH (ng(ml)	*ad libitum*	0,78 ± 0,33$^{a\ B}$	1,09 ± 0,31$^{a\ A}$	0,67 ± 0,19$^{A\ B}$
	restricted	0,11 ± 0,09$^{b\ B}$	0,28 ± 0,18$^{b\ A\ B}$	0,62 ± 0,22^{A}
Number of LH pulse (n)	*ad libitum*	1,0 ± 0,3$^{A\ B}$	1,8 ± 0,4$^{a\ A}$	1,0 ± 0,5^{B}
	restricted	0,2 ± 0,2	0,2 ± 0,2^{b}	1,0 ± 0,5
LH pulse magnitude (ng/ml)	*ad libitum*	1,13 ± 0,33^{A}	1,41 ± 0,20$^{a\ A}$	0,69 ± 0,32^{B}
	restricted	0,25 ± 0,25	0,26 ± 0,26^{b}	0,78 ± 0,35

Values are given as mean ± SE.
[1]Blood samples were taken every 15 min for 11 h on days 12, 15 and 18 post partum (1 ± day). Values with different superscripts differ significantly with a column (a.b) and row (A.B) for the respective parameter.



Picture 3. Concentrations of FSH in frequently taken blood samples of sows fed restricted (n=5) or *ad libitum* (n=5) diets on days 12, 15 and 18 of lactation (Every 15 min for 11h starting 07 am)



Picture 4. Concentrations of LH in frequently taken blood samples of sows fed restricted (n=5) or *ad libitum* (n=5) diets on days 12, 15 and 18 of lactation (Every 15 min for 11h starting 07 am)

The variance in FSH secretion patterns can be observed in picture 4. In comparison to FSH the effect of nutrition level during lactation on LH is not so high. The mean concentration of LH is between 1.5 to 2.0 ng/ml. The difference is not significant.

CONCLUSION

Feeding during lactation has been shown to effect physiology of reproduction in sows. A study was conducted to define the hormonal patterns of FSH and LH in lactation (21 days), the development of uterus and follicles after weaning in primiparous sows fed restricted (RE) or ad libitum (AL).

Generally high nutritional intakes during lactation influenced features of reproduction positively.

AL-sows achieved a significantly higher rearing performance than RE-sows.

Development of the uterus and ovaries after weaning was delayed by restricted nutrition. An association to simultaneously observed differences in follicular growth was assumed. 24 hours and 7 days after weaning the weights of uterus were higher in AL-sows (399/478g) than in RE-sows (335/392g). Generally the follicular status of AL-sows was further developed than in RE-sows.

The results demonstrate that lactating primiparous sows fed ad libitum had both higher LH and FSH concentrations during lactation than sows fed a restricted diet. An association to simultaneously observed differences in follicular growth was assumed.

FSH concentration were similar in AL- and RE-sows on day 12 pp, but higher in AL-sows on day 15 and day 18 pp ($P<0,05$). Generally LH concentration was higher in AL- than in RE-sows ($P<0.05$). Lactating AL-sows had higher LH and FSH concentrations during lactation than RE-sows.

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SAŽETAK

Pokazalo se da hranidba za vrijeme laktacije djeluje na fiziologiju reprodukcije u krmača. Istraživanje je provedeno da se u krmača prvopraskinja, hranjenih ograničenim obrocima (RE) ili *ad libitum* (AL), odredi hormonalna struktura FSH i LH u laktaciji (21 dan) te razvoj uterusa i folikula nakon odbića prasadi.

Istraživanje je provedeno na 14 krmača, 7 iz skupine AL i 7 iz skupine RE (=70% obroka AL krmača). Intravenozni kateter je umetnut 6/7 dan post partum (pp). Uzorci krvi uzimani su 12.,15. i 18. dan pp. FSH i LH su analizirani pomoću RIA. Dnevna ultrasonografija jajnika primijenjena je između 8. i 20/21. dana pp na nekoliko životinja po skupini radi praćenja folikularnog rasta. Sve su krmače žrtvovane 1. ili 7. dana poslije odbića. Prosječni dnevni unos hrane za vrijeme laktacije bio je 3.9 kg u AL krmača i 2.7 kg u RE krmača. Koncentracije FSH bile su slične u AL i RE krmača 12. dana pp ali više u AL krmača 15. i 18. dana pp ($P<0.05$). Općenito su LH koncentracije bile više u AL krmača nego u RE krmača ($P<0.05$). Rezultati pokazuju da su koncentracije LH i FSH u laktaciji bile više u AL nego u RE krmača. Povezanost s istovremeno primijećenim razlikama u folikularnom rastu utvrđena je 24 sata i 7 dana poslije odbića. Težine uterusa bile su više u AL krmača (399/478) nego u RE krmača (335/392). Općenito je folikularno stanje AL krmača bilo razvijenije nego u RE krmača.

Ključne riječi: hranidba, krmače, laktacija, razvoj folikula