Pre-implantation protein levels to mink – effects on fetal survival and reproductive performance

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Introduction

Mink protein/amino acid requirements for gestation are incompletely known

Previous studies cover

- Entire period December to weaning (e.g. Skrede, 1978)
- Completed implantation until parturition (e.g. Clausen et al., 2007; Clausen & Sandbøl, 2007, 2008, 2010)
- Last 2/3 of true gestation (e.g. Matthiesen et al., 2010; Vesterdorf et al., 2012)

Introduction

Period from mating to implantation not investigated separately

The length of the embryonic diapause varies

Mating – implantation not a fixed time period

Hence difficult to target precisely

- Mating to ovulation ~ 2 days
- Transport to uterus ~ 6 days
- Embryonic diapause ?
- True gestation 30 ± 3 days

Objective and hypothesis

Objective

To determine the mink pre-implantation protein/amino acid requirement by different experimental approaches

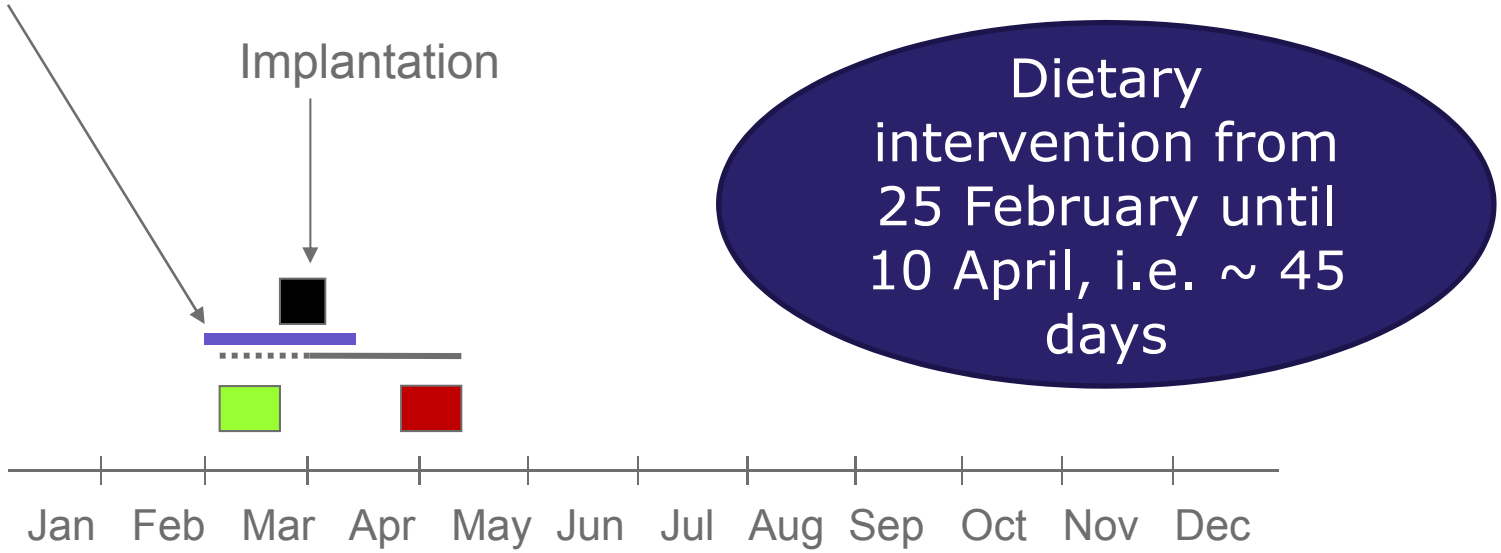
Hypothesis

A protein provision of 25 – 30% of ME sustains the protein requirement for the pre-implantation period

Materials and methods

Different levels of protein provision before implantation

After completed implantation same adequate protein provision



Materials and methods

Experiment 1: 6 diets
20, 25, 30, 35, 40 and 45% of ME from protein

Dams mated the 2nd + 10th of March

Euthanized 16 April

Studied traits:
Implantation rate & fetal survival

Materials and methods

Experiment 2:

3 diets - 25, 30 and 35% of ME from protein

Dams mated 1 + 8 starting 4 March,

from 13 March 1+1 (very few)

Studied traits

- Reproductive performance
- Kit survival rate
- Kit birth weight
- Kit preweaning growth

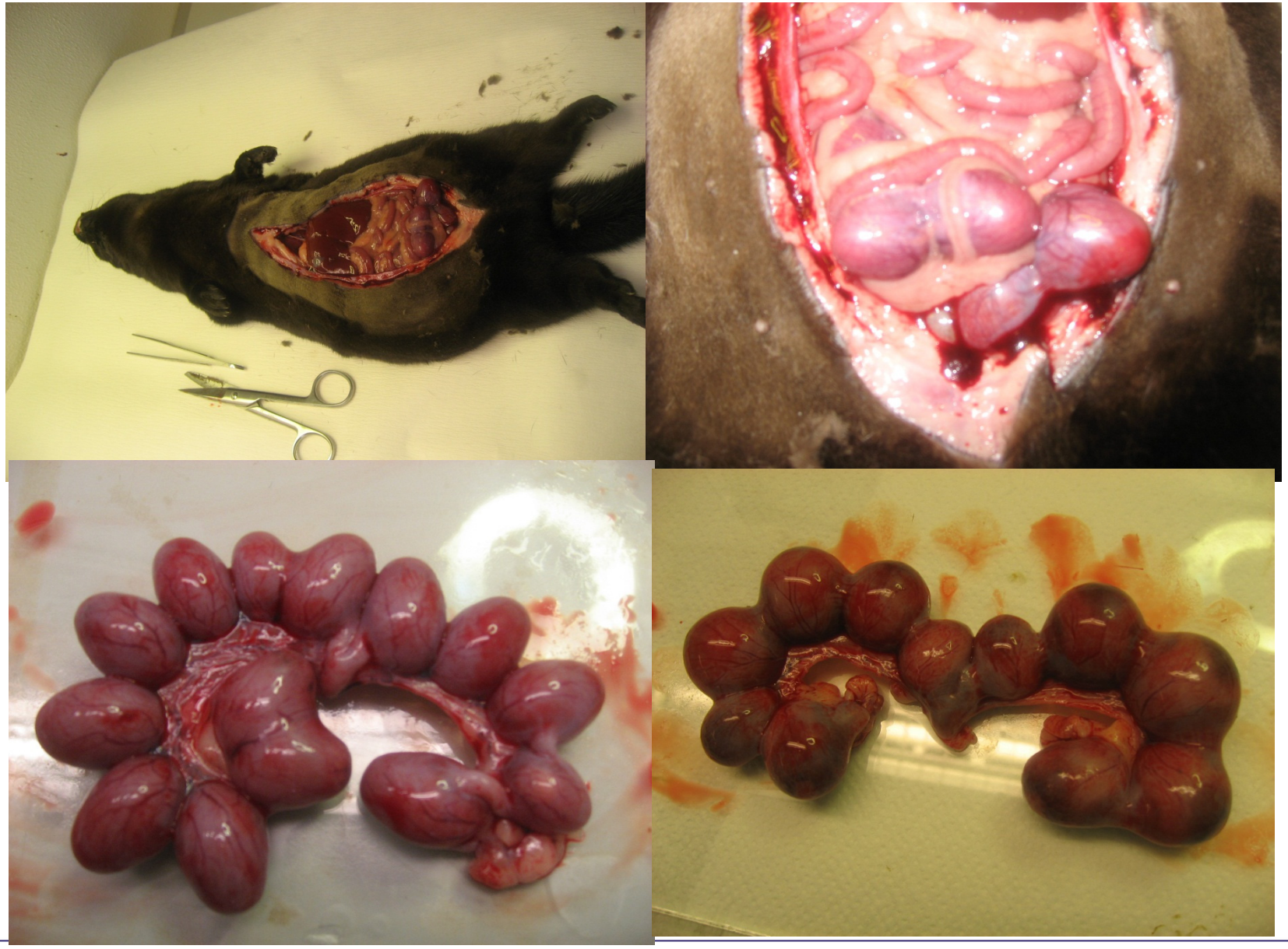
Materials and methods

Protein provision, % of ME	No. of dams per treatment group	
	Experiment 1	Experiment 2
20	3	-
25	3	26
30	3	26
35	3	26
40	3	-
45	3	-
Total	18	76

Dietary composition, g/kg feed

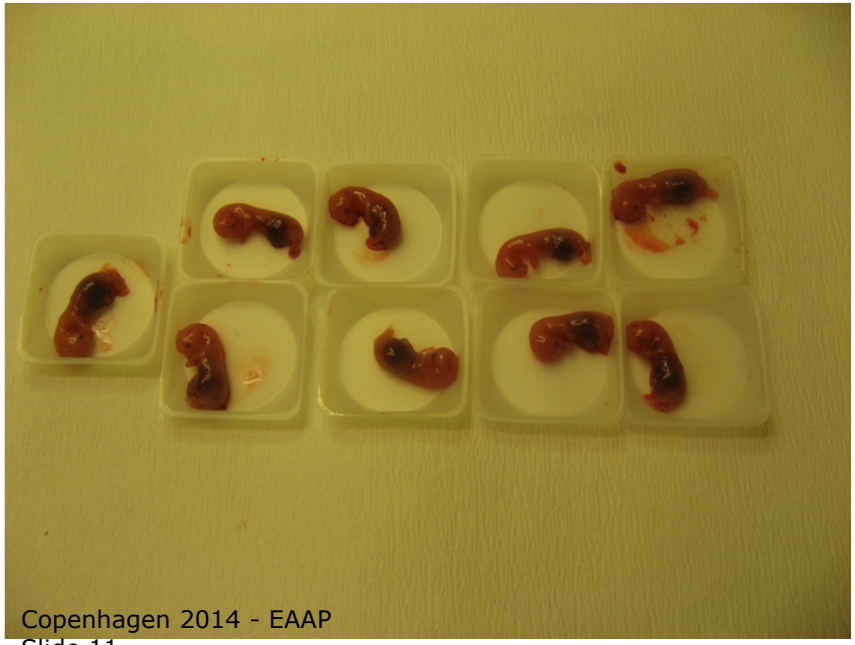
	20 P	25 P	30 P	35 P	40 P	45 P
Fat : CHO, % of ME	49 :31	49 : 25	50 : 20	47 : 18	44 : 16	41 : 14
Fish offal, 3-5% fat	80	50	50	122	196	270
Industrial fish, 8-12 % fat	400	400	411	370	330	290
Poultry by-products	60	170	170	178	185	193
Fish silage	10	18	19	20	20	20
Barley, popped	100	90	79	63	52	42
Wheat, popped	100	90	79	63	52	42
Porcine blood meal, DAKA	12	12	12	30	30	30
Corn gluten meal	8	5	49	22	30	30
Potato protein	5	11	30	0	6	16
Soy oil	55	32	27	17	10	4
Lard	15	15	13	8	1	2
Corn starch	70	23	0	0	0	0
Vitamins & minerals	2	2	2	2	2	2
Water	*Ad* 1000					

Results, Experiment 1, dams euthanized 16 April

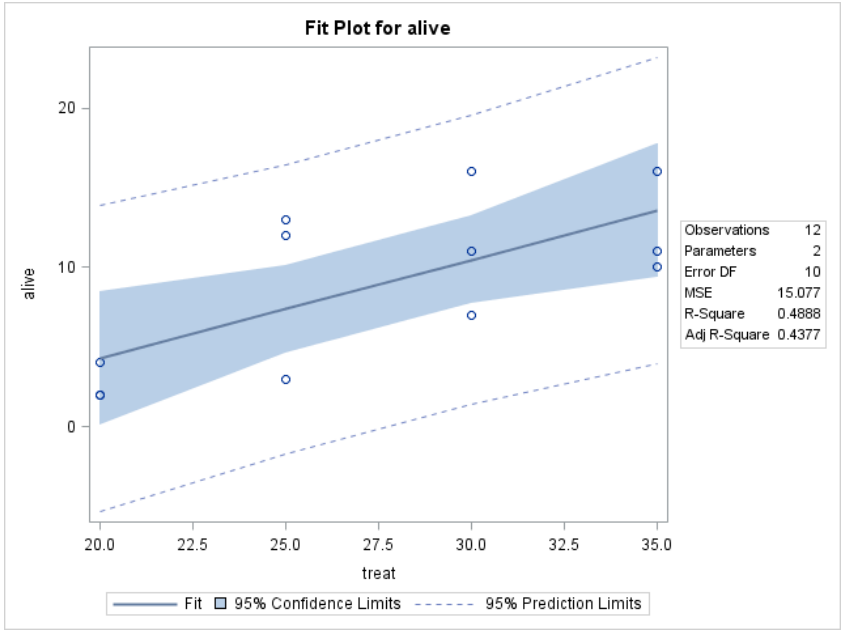


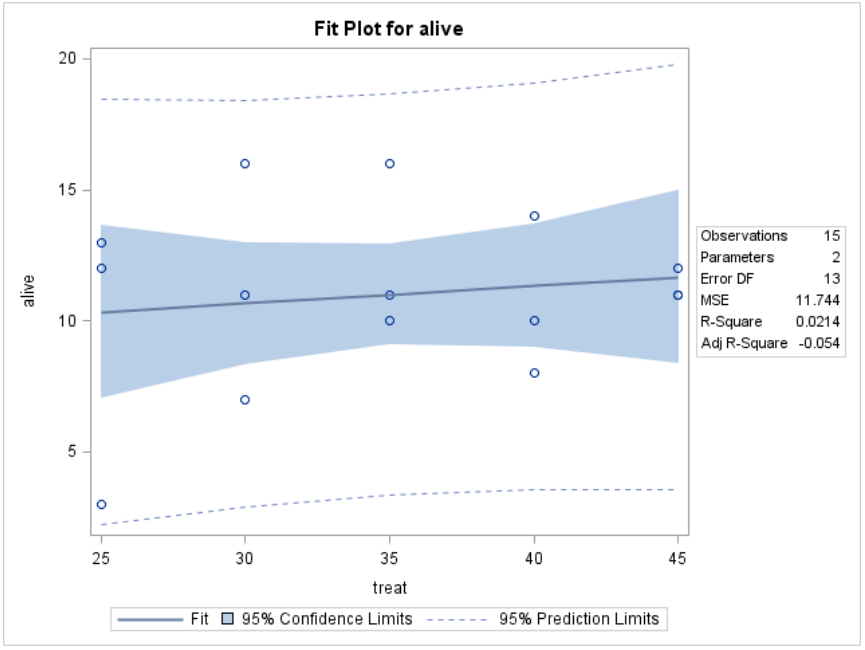
Results, Experment 1, dams euthanized 16 April

	20 P	25 P	30 P	35 P	40 P	45 P	*P*-value
Implantation sites	9.3	9.7	11.3	12.3	10.7	11.3	NS
Live foetuses	2.7[a]	9.3[b]	11.3[b]	12.3[b]	10.7[b]	11.3[b]	<0.05
% live foetuses	29[a]	97.6[b]	100[b]	100[b]	100[b]	100[b]	0.03

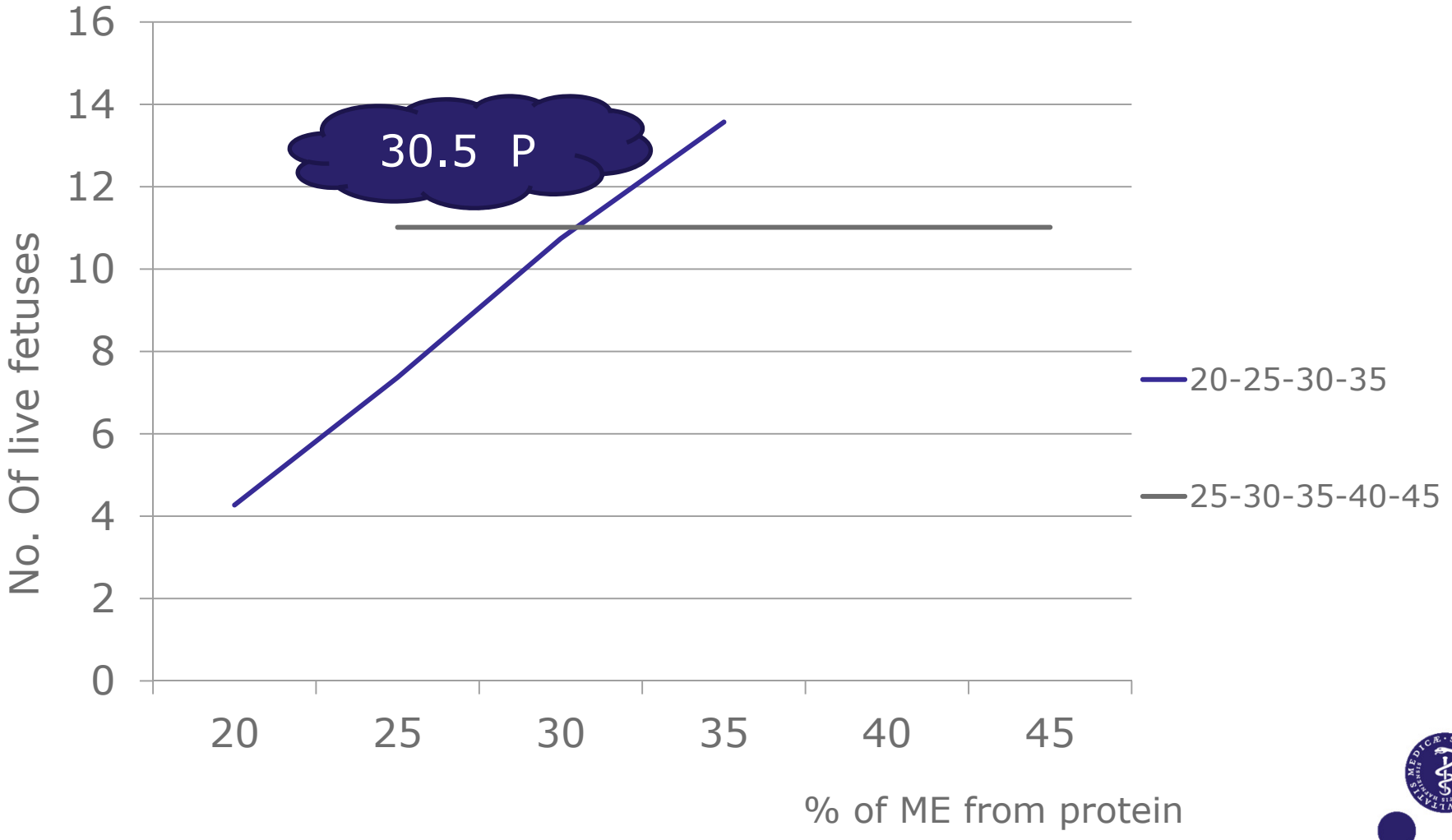


Linear regression – number of live fetuses





Broken line linear regression approach



Conclusion, Experiment 1

The broken line linear regression approach suggested that:

- *The pre-implantation protein requirement is 30.5% of ME*

Results, Experiment 2: Reproductive performance and kit birth weights

	25 P	30 P	35 P
n	26	26	25
Barren females, %	15^{ab}	23^{a}	0^{b}
Total no. of kits per litter	8.6	8.8	8.0
Live born kits per litter	7.9	6.8	6.9
Stillborn kits, %	9.3	21.6	13.8
Live born kits per mated female	6.7	5.2	6.9
Kit survival rate until 49 days, %	85	88	77
Birth weight, live kits, g	10.7^{A}	10.8^{A}	11.4^{A}
Birth weight, stillborn kits, g	9.1^{B}	8.6^{B}	9.0^{B}

$^{a\ b}$ Values in a row with different lower case superscript differ significantly, $P<0.05$

$^{A\ B}$ Values in a column with different upper case superscript differ significantly, $P<0.05$

Results, Experiment 2, kit live weights, g

Age, days	Male kits			Female kits		
	25 P	30 P	35 P	25 P	30 P	35 P
7	37.9	34.9	37.1	36.0	33.3	33.5
14	82.2	80.0	86.2	77.8	73.8	75.9
21	143.6	133.5	148.9	132.7	121.6	131.2
28	208.0^{a}	193.9^{b}	211.8^{a}	191.3^{a}	173.9^{b}	187.2^{ab}
35	270.0	266.4	274.8	252.0^{a}	238.1^{b}	243.0^{a}
42	417.0^{a}	404.8^{b}	408.1^{ab}	389.2^{a}	354.4^{b}	364.9^{b}

$^{a\ b}$ Values within sex in a row with different superscripts differ significantly, $P<0.05$

Conclusion, Experiment 2

- Results in group 30 P generally poorest
  -Reason presently unknown

- Results in group 25 P in line with those in group 35 P suggesting that
  -The pre-implantation protein requirement is sustained with 25% of ME from protein

Conclusion

Based on implantation rate 20% of ME sufficient pre-implantation protein provision

Fetal survival rate and reproductive performance suggested that the requirement was sustained by 25 – 30% of ME from protein

- Dietary intervention early post implantation may have contributed to these differences

Conclusion

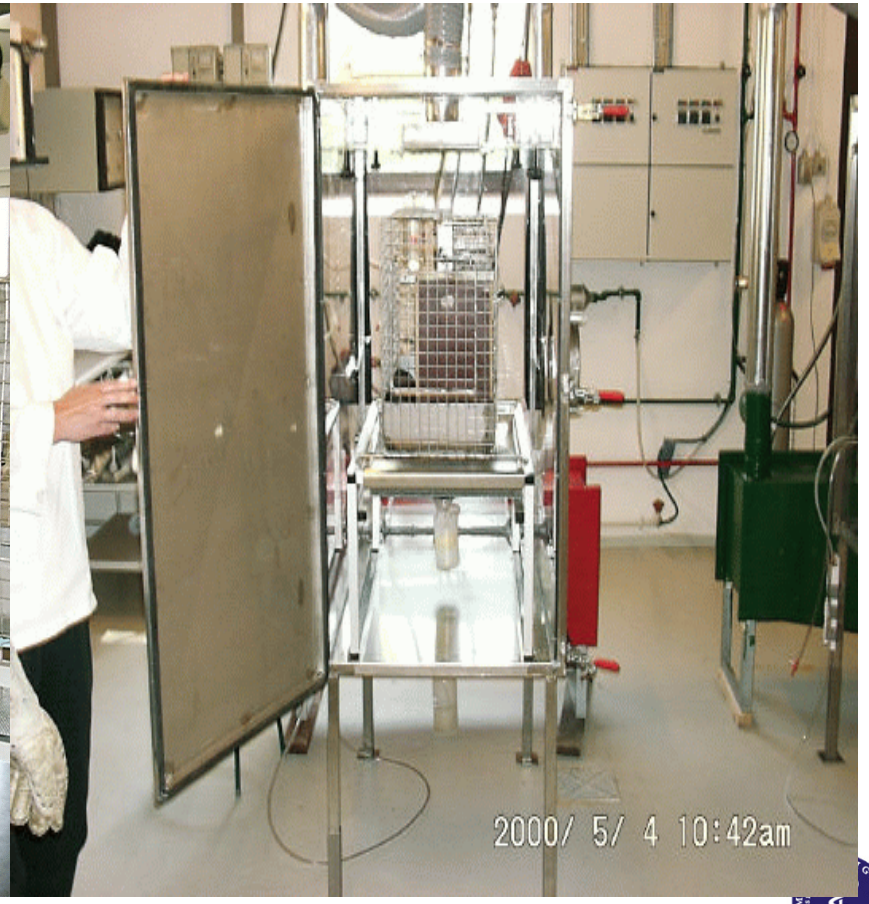
Future studies ought to target pre-implantation period better

- However, embryonic diapause is short and variable
- Probably difficult to make a clear-cut determination of the pre-implantation protein requirement, but
- From a practical point of view it accounts for a very small amount of the entire production cycle protein requirement
- Therefore, acceptable if requirement values have a slight overlap with the values for true gestation

Thank you for your attention

Expt. 1: Balance, respiration and IAAO

- 5 measurements per group over 3 weeks



Discussion

It was not possible to target the pre-implantation period precisely

- Experimental feeding started before matings
- Lasted until 10 April when almost all females had implanted
- Therefore some overlap with pre-mating and post implantation periods
- Significance of which is unknown

Discussion

	25 P	30 P	35 P	*P*-value
Diet intervention after implantation, days	9.5	8.2	8.2	NS
Embryonic diapause, days	17.6	19.5	18.2	NS
Gestation length, days*	46.6	48.6	47.9	NS

* From last mating until parturition

Discussion

- However, this overlap was similar in all groups
- Therefore, similar influence in all groups
- Implantation rate was not affected by the dietary intervention, but fetal survival was

  -Effect of the early post-implantation dietary intervention cannot be excluded