- Session 24
- Free Communications. Sheep and Goat Commision
- Arana et al., pdf
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Adipose cellularity but not lamb growth was affected by vitamin A supplementation during early post-natal development

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Nutritional agents influencing “in vitro” adipocyte differentiation

* PUFA (Azain, 2004)

* CLAs (Amri et al., 1994)

- Vitamin A

** inhibitory --- (Sato et al., 1980;
Brandebourg and Hu, 2005)

** stimulating --- (Safonova et al., 1994)

Vitamin A effect in lambs “in vivo”

* Payne and Watkins (1997)

  growing lambs from 30 to 46 kg BW

  340 mg/animal, 2 times/week

  ⟶ No effect in the SC amount of fat

* Arnett et al. (2007)

  growing lambs from 28 to 61 kg BW

  6600 IU/kg feed, daily

  ⟶ Marbling score increased

Adipose tissue development

Hyperplasia

Hypertrophy

+

“de *novo*” Synthesis

Fatty Acids Uptake

Different development of the depots

Ovine (Rasa Aragonesa breed)

- 15 kg (45 days of age)– onwards….

- – PR,

  → Hyperplasia completed or in an advanced phase
  Development by hypertrophy

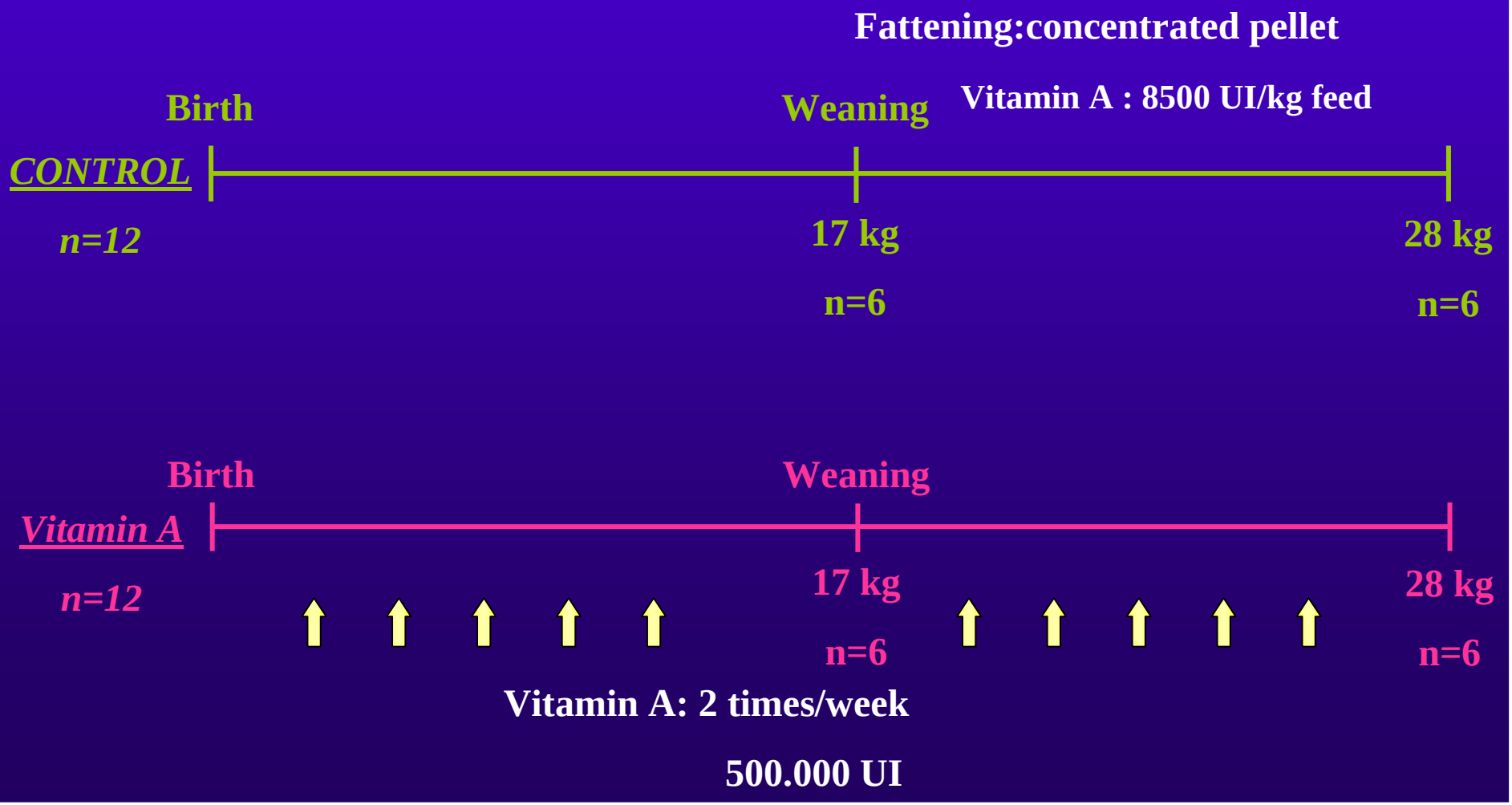
- – OM, SC, IM

  → Development by hyperplasia and hypertrophy

Objective

To study the vitamin A effect on lamb growth and adipose tissue development from birth to 27 kg BW (100 days of age)

Male Rasa Aragonesa lambs



Growth and carcass parameters

- Average Daily Gain
- Serum retinol and serum retinol-palmitate at birth, at weaning and at slaughter (HPLC)
- Liver retinol and retinol-palmitate at slaughter (HPLC)
- Hot Carcass Weight

Adipose tissue parameters

- OM and PR amount of fat
- Shoulder dissection → SC and IN amount of fat
- *Longissimus Muscle* lipid content
- Adipocyte size and number (Robdell,1964)

Statistical analysis

ANOVA (two factors)

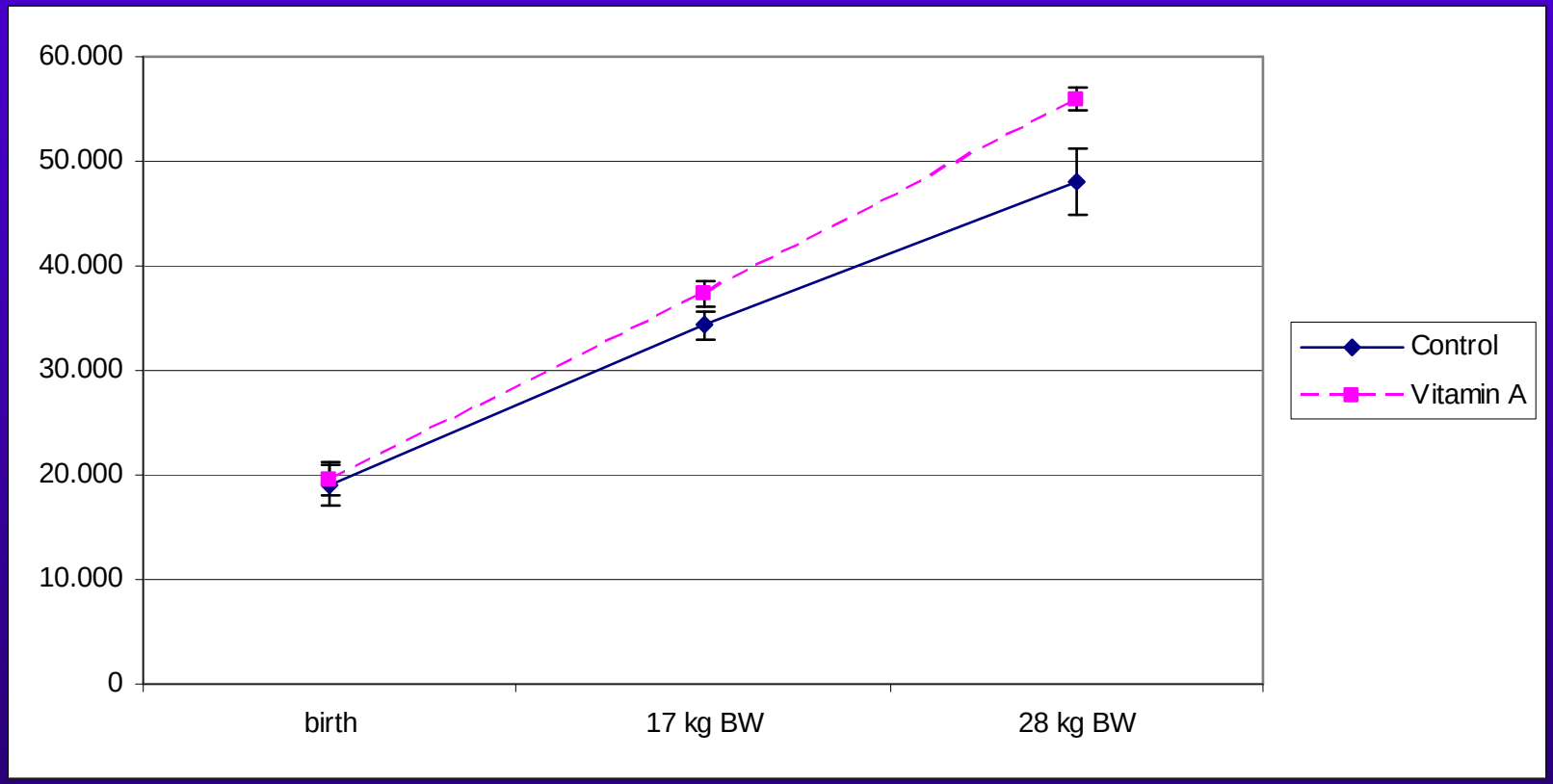
$$y_{ijk} = \mu + G_i + W_j + G_i \times W_j + e_{ijk}$$

μ= mean value

Gi = fixed effect of Group (i = 1: Control; i = 2: Vitamin A)

Wj = fixed effect of BW at slaughter (j =1: 17 kg; j = 2: 28 kg)

Serum retinol



Liver retinol

(at 28 kg BW)

Control: 3.98 mg/g tissue

Vitamin A: 23.59 mg/g tissue

Growth Parameters

	C	V	17kg	28kg	G	W	GxW
Birth weight, kg	4.6	4.6	4.8	4.5	n.s.	n.s.	n.s.
Weaning weight, kg	16.8	16.8	16.9	16.7	n.s.	n.s.	n.s.
Weaning age, d	59	58	58	58	n.s.	n.s.	n.s.
ADG birth-weaning, g/d	222	220	219	223	n.s.	n.s.	n.s.
Slaughter weight, kg	22.7	22.9	16.9	27.8	n.s.	***	n.s.
Slaughter age, d	80	82	58	101	n.s.	***	n.s.
ADG wean.-slaugther, g/d	233	229	219	241	n.s.	n.s.	n.s.

Carcass and Composition Parameters

	C	V	17kg	28kg	G	W	GxW
HCW, kg	10.8	11.0	7.8	13.4	n.s.	***	n.s.
Omental fat, g	249.9	243.6	149.3	330.3	n.s.	***	n.s.
Perirenal fat, g	232.8	245.2	146.3	318.5	n.s.	***	n.s.
Liver weight, g	515	518	373	640	n.s.	***	n.s.
Shoulder weight, g	1012	1022	782	1219	n.s.	***	n.s.
Subcutaneous fat[2], g	51.4	63.4	43.1	69.7	n.s.	***	n.s.
Intermuscular fat[2], g	80.0	88.0	59.9	104.6	n.s.	***	n.s.
LM fat content, %	1.33	1.39	1.42	0.89	n.s.	**	n.s.

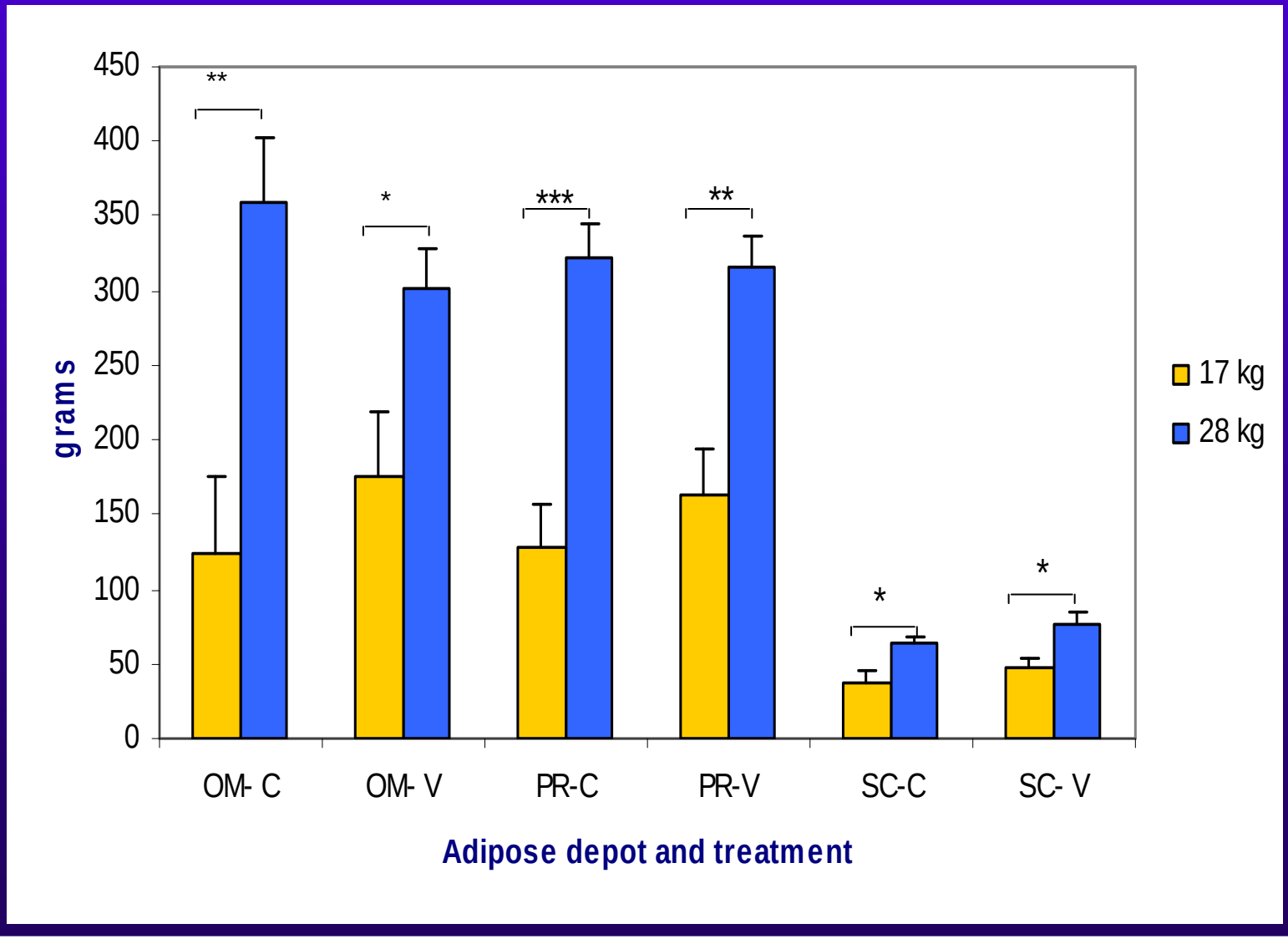
[2] Extracted from the shoulder

Adipose Tissue Parameters

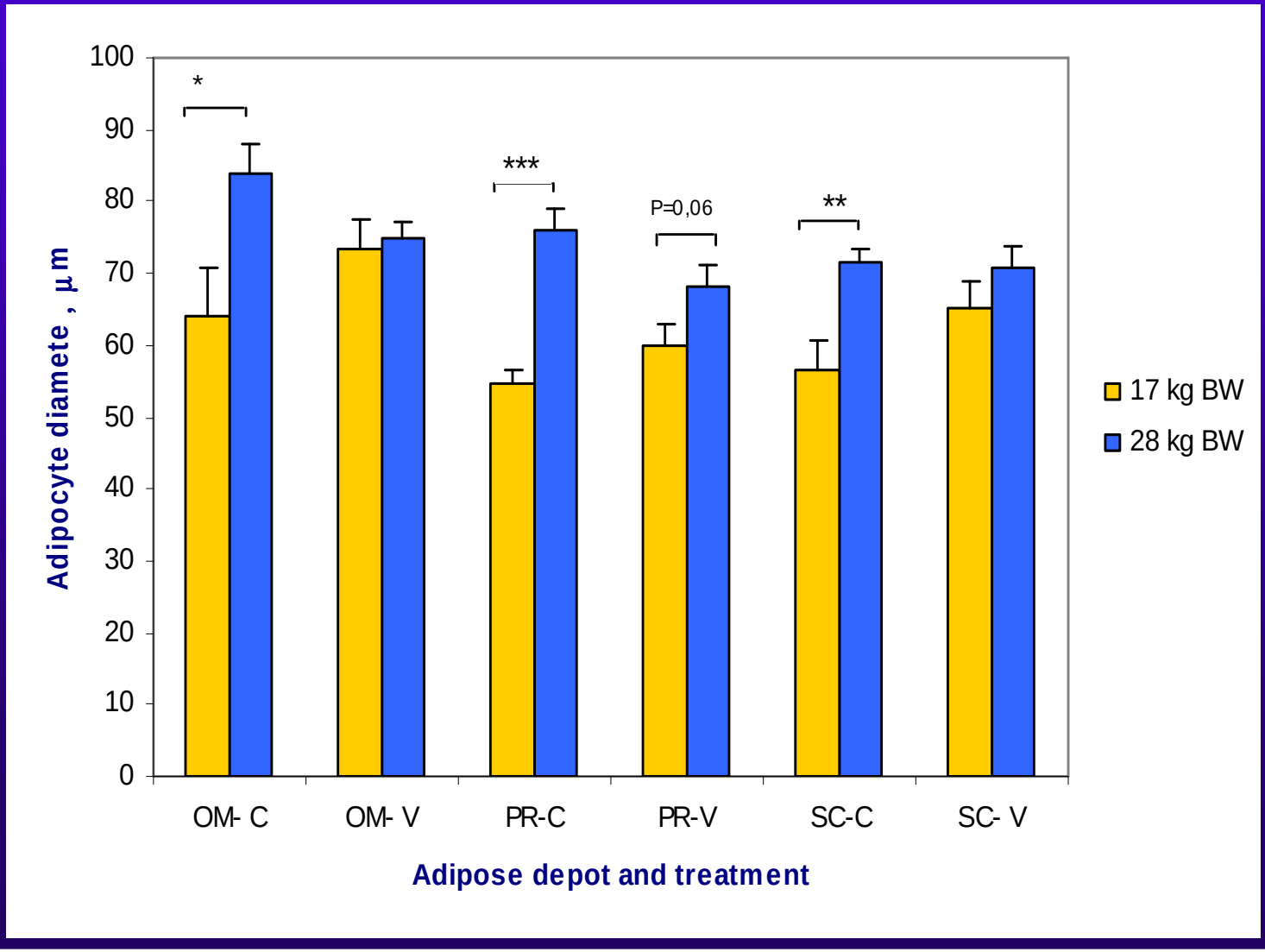
	C	V	17kg	28kg	G	W	GxW
Adipocyte diameter, µm							
Omental	74.6	74.3	68.7	79.4	n.s.	*	*
Perirenal	66.0	64.4	57.2	72.1	n.s.	***	*
S.c.[2]	64.5	68.1	60.8	71.1	n.s.	**	+
Adipocyte number, 10^6							
Omental	763	882	582	1028	n.s.	***	n.s.
Perirrenal	1215	1458	1206	1449	n.s.	n.s.	+
S.c.[2]	202	185	170	214	n.s.	**	*

[2] Extracted from the shoulder

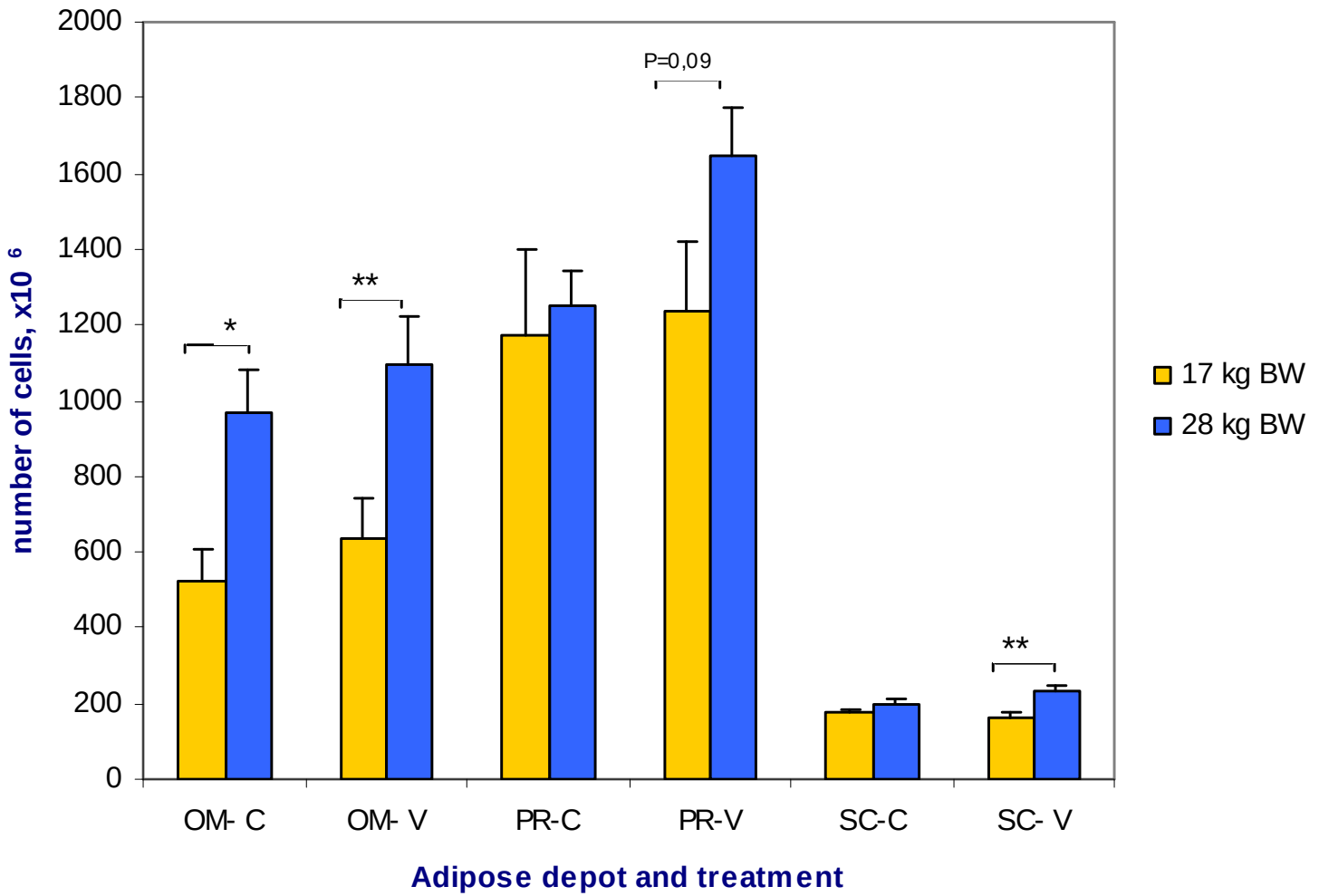
Adipose Tissue Weight



Adipocyte hypertrophy



Adipocyte hyperplasia



Summary of "in vivo" differences

Between species

Lambs High 6.600 IU vitA /kg feed ---Increase on IM marbling score. Arnett et al. (2007)

Steers: Low vitamin A level on feed—increase on IM marbling score Gorocica-Buenfil et al. (2007)

Between depots

Lambs 6.600 IU vitA /kg feed No influence on SC fat but increases IM lipid content. Arnett et al. (2007)

Between doses

Matsuzaki et al. (1998) – 0 or 1500 IU/kg feed--No effect on fataccumulated

Gorocica-Buenfil et al. (2007) – 1300 IU/kg feed --- Increase on marbling score

Differences at cellular and molecular level?

- Molecular level: sequential expression of transcription factors: CCAT, PPARg
- Differences between depots (Soret et al., 2000; Martínez et al., 2006)
- Depends on cell vitamin A concentration (Sato et al., 1980)
- Depends on the stage of cell differentiation

Reasons of differences are still unknown

- Differences on cell vitamin A concentration?

- Other factors besides the role of Vitamin A in transcription factors expression

- Vitamin A induces vasculogenesis, which could increase the nutrient adipocyte availability and, therefore, the fatty acid uptake favouring preadipocyte differentiation?

CONCLUSION

In this experience, effect of vitamin A supplementation:

*** No influences:**

growth, carcass variables and LM lipid content

*** Increases hyperplasia**

*** Decreases hypertrophy**

(in a depot specific manner depending on their degree of maturity)

More studies are needed to dilucidate differences between species, depots…… and to devise methods for modifying adiposity