

## Growth of skeletal muscle and IGF-I in pigs of different sex

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### Background

Insulin-like growth factor I is a pluripotent factor that is involved in the regulation of growth, in differentiation and in a large number of functions in numerous tissues and cells. In adult animals the hormone is synthesized first of all by the liver and then secreted into circulation. The plasma levels vary strongly depending on sex, age and diet. Insulin-like growth factor I acts in circulation as classical endocrine agent by interacting with specific cell-surface receptors. A multitude of extrahepatic tissues (e.g. musculature) is able to produce Insulin-like growth factor I. Paracrine, endocrine and autocrine effects are well established.

### Objectives

We describe in our experiment the postnatal growth of the skeletal muscles in pigs of various sex depending on different hormones especially Insulin-like growth factor I.

Objectives of this study were

- to investigate the plasma levels of Insulin-like growth factor I in pigs from birth to slaughter depending on sex
- to find differences in muscle fibre diameter in M.triceps brachii and M.longissimus in male, female and castrated animals
- to specify interactions between the plasma levels of Insulin-like growth factor I and muscle fibre diameter during the course of growth.

### Methods

Forty two crossbred pigs of the genetic construction Pi x (LW x GL). We selected to minimize the environmental effects for birthweight. The differences were less than 50 g. So we chose per litter one male, one female and one castrated animal. The fattening period was from day 28 to 210 in single boxes. Diet was given ad libitum. During fattening 7 blood samples per animal were drawn for investigation of Insulin-like growth factor I. The plasma concentration of Insulin-like growth factor I was measured at the Research Institute for Biology of Farm Animals Dummerstorf. For the determination of muscle fibre number and muscle fibre diameter as well as further muscle structural and biochemical traits a shot biopsy samples were taken from the living animal at 13th/14th rib of M. longissimus. From the M. triceps brachii a biopsy sample were taken from Caputh longum with a quick-core biopsy needle under ultrasonic control. Furthermore, we examined the muscle area of M.longissimus dorsi and M.triceps brachii with ultrasonography.

After preparation of freezing cuts the presence of ATPase and Diaphorase was determined histochemically. Microstructural characteristics of the muscle fibres were determined by a semiautomatic image analysis system (Lucia M).

All data were analysed with SAS version 6.10 (SAS Inst. Inc. 1989) and STATISTICA for Windows (Vers. 5.1 Stat Soft Inc. 1996) by means of variance analysis. Differences ( $p = 0,05$ ) are indicated by different letters.

### Results and discussions

Insulin-like growth factor I plasma concentrations show the expected increase during the fattening period (Table 1). Boars have the highest results and a maximum around day 150. They also have the highest growth rates (80-100 kg body weight) in this time. Barrows develop their highest growth rates earlier, approximately around day 111 (60 kg body weight). We found significant differences between boars and sows after day 111 and between boars, barrows and sows on day 180. We explain our relatively high plasma-levels in connection with sex-, breed- and method specific differences. BUONOMO et al. (1987) also received high IGF-I plasma-levels in fast growing breeds. CLUTTER et al. (1995) found 250 ng/ml IGF-I in gilts selected for high daily weightgain. WEILER (1995) reported on a breed- sex- and diet- depending Insulin-like growth factor I secretion in connection with age-dependent changes in property of growth. There are no significant differences between the sexes in mean muscle area ( $\text{cm}^2$ ) measured by ultrasonography (Table 2.).

The area of M.triceps brachii in sows at 180 days is significantly smaller than in boars and barrows.(Table 3.). Boars tend to have the largest areas in the given muscle. The increase of muscle area in the M.triceps brachii appears more linear than in M.longissimus dorsi.

The mean muscle fibre diameter ( $\mu\text{m}$ ) of M. longissimus dorsi was similar in all sexes (Table 4). Boars tend to have the biggest fibres on day 200. KNUDSON et al (1985) also found no significant differences between boars and barrows. In contradiction to this FIEDLER et al. (1994) reported on 5-10  $\mu\text{m}$  thicker fibres in boars compared to barrows.

Significant differences between sexes were not found in muscle fibre diameter contrary to our expectations in M. triceps brachii (Table 5). Animals of a group with an average muscle fibre diameter of more than 94  $\mu\text{m}$  (200th day of life) in M.triceps brachii have higher concentrations of Insulin-like growth factor I than animals of the group with an average muscle fibre diameter ( $\mu\text{m}$ ) of less than 94  $\mu\text{m}$ . Significant differences were found on day 78, 151 and 200 (Fig. 1). Animals of the group with an average muscle fibre diameter of more than 106  $\mu\text{m}$  in M. longissimus tend to higher concentrations of Insulin-like growth factor I than animals of the group with an average muscle fibre diameter of less than 106  $\mu\text{m}$ . The differences between the groups are not significant (Fig. 2).

## Conclusions

- At the end of the fattening period boars have approximately twice the concentrations of IGF-I than barrows and sows.
- There are no significant differences in mean muscle fibre diameter between sexes in the examined muscles.
- Animals with high diameter in muscle fibres of M.triceps brachii (200th day of life) have significantly higher IGF-I concentrations in blood plasma.
- Phenotypic differences between sows and boars in thickness of shoulder muscle are confirmed after the 181. day of life with ultrasonographic data.

## References

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Table 3: LS-Means of muscle area (cm<sup>2</sup>) of M. triceps brachii depending on age and sex

Age in days	Area M. triceps brachii		
	barrow LSM	boar LSM	sow LSM
32	6.93 a	6.93 a	6.95 a
78	16.28 a	15.91 a	15.40 a
151	28.36 a	26.32 a	27.12 a
180	34.82 a	35.19 a	31.88 b

Table 4: LS-Means of muscle fibre diameter (µm) of M. longissimus dorsi depending on age and sex

Age in days	muscle fibre diameter M.l.d.		
	barrow LSM	boar LSM	sow LSM
78	62.7 a	60.3 a	63.1 a
151	93.7 a	90.7 a	91.4 a
180	101.8 a	95.8 a	100.0 a
200	106.4 a	107.9 a	104.8 a

Table 5: LS-Means of muscle fibre diameter (µm) of M. triceps brachii depending of age and sex

Age in days	muscle fibre diameter M.t.br.		
	barrow LSM	boar LSM	sow LSM
32	41.5a	41.6a	41.0a
78	59.5 a	66.1 b	70.5 b
151	93.2 a	90.0 a	88.6 a
180	97.8 a	93.5 a	91.5 a

Table 1: LS-Means of IGF-I-plasma concentrations (ng/ml) depending on age and sex

Age in days	IGF-I		
	barrow LSM	boar LSM	sow LSM
1	39.5 a	36.6 a	39.5 a
32	119.7 a	115.2 a	131.1 a
78	161.4 a	179.8 a	190.5 a
111	226.6 ab	293.0 a	195.2 b
151	169.6 a	394.5 b	211.9 a
180	142.3 a	374.2 b	202.5 c
200	130.3 a	379.1 b	184.4 a

Table 2: LS-Means of muscle area (cm<sup>2</sup>) of M. longissimus dorsi depending on age and sex

Age in days	Area M. longissimus dorsi		
	barrow LSM	boar LSM	sow LSM
32	6.09 a	6.93 a	6.48 a
78	15.29 a	15.40 a	15.90 a
151	40.40 a	38.10 a	40.10 a
180	46.90 a	46.30 a	45.00 a

Fig. 1: IGF-I concentration in blood plasma of pigs after classification in groups of fibre diameter (FD) in M. triceps brachii (LSM, SEM)

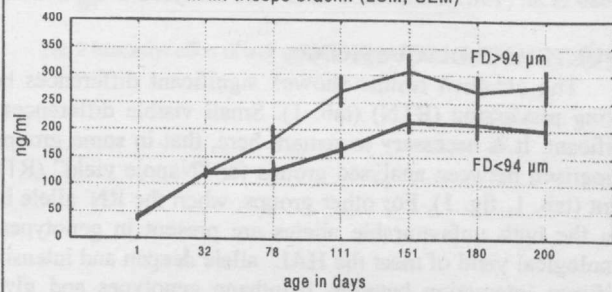


Fig. 2: IGF-I concentration in blood plasma in pigs after classification in groups of fibre diameter (FD) in M. longissimus (LSM, SEM)

