



Skatole pattern during the growth period 50 to 100 kg liveweight in entire male pigs of the crossbreed combinations YDxLYD and HxLYD kept in groups of entire male pigs or in groups with dominant female pigs

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It has been shown that the androstenone level is dependent on the rank order of the pigs, which suggests that low-ranking pigs take longer to reach sexual maturity than the dominant pigs (Jonsson, 1985; Jonsson & Jørgensen, 1988; Giersing, 1995; Giersing et al., 1997; Giersing et al., 2000).

Low rank of male pigs could to a great extent be ensured by mixing these with 15 kg heavier and 3 weeks older females, if they are mixed at a low weight and age (Ruschen, 1987). A significant result in relation to the experimental design suggested below is that the effect of rank order on the androstenone level in low-ranking male pigs is stronger if the females dominate the pen (Giersing et al., 1997; Giersing et al., 2000). This choice spurs higher ranking male pigs and thus probably correspondingly high androstenone and skatole levels, as sexual maturity occurs at a relatively early time (often before 100 kg liveweight) (Claus et al., 1994; Giersing, 1995; Giersing et al., 1997; Giersing et al., 2000; Neupert et al., 1995).

Introduction

The amounts of skatole and androstenone in blood and fat tissue depend on rate of synthesis/production as well as of degradation. Several experiments indicate an increase in skatole and androstenone content in fat of certain male pigs (genetically determined) with increasing age and weight as a consequence of increased production of male hormones i.e. testosterone and estrogenes (Babol et al., 1997; Hansen et al., 1997a,b; Squires & Lou, 1995; Doran et al., 2002).

There are indications of a simultaneous increase in the concentration of androstenone and skatole in male pigs with genetic disposition for high skatole level (Babol et al., 1997b; Hansen et al., 1997b, Doran et al., 2002).

This suggests that if the sexual maturity of male pigs with a certain genetic disposition for high skatole and androstenone levels can be delayed, the pigs will probably display a much lower skatole and androstenone level at weights/ages, where they normally would be sexually mature (Jonsson, 1985; Jonsson & Jørgensen, 1988; Giersing, 1995; Giersing et al., 1997; Giersing et al., 2000).

Aim:

It was the aim of this experiment to show that entire male pigs of 20 kg liveweight mixed with 3 weeks older female pigs (35 kg) (dominant female pigs) reach sexual maturity later and thus have lower skatole and (androstenone) levels in blood and backfat than entire male pigs living in entire male pig groups during the same liveweight period (50, 75 and 100 kg) based on the assumption that some of the pigs have genetic potential for high skatole and/or androstenone levels at sexual maturity. Genetically “normal” male pigs are assumed to have “always” low skatole and androstenone levels at sexual maturity (Hansen et al., 1997b).

Furthermore it is expected that entire male pig offspring of the crossbreed Hampshire sire x LandraceYorkshireDuroc dam (HxLYD) has more pigs with high skatole and androstenone levels at normal slaughter weight (100 kg) compared to the crossbreed YorkshireDuroc sire x LandraceYorkshireDuroc dame (YDxLYD) usually used in outdoor pig production in Denmark (Sorensen & Pedersen, 1994).

Material and methods:

Control treatments with entire male pigs

In order to be able to observe a clear effect of female dominance (social rank) on androstenone and skatole levels in male pigs, a control group is made consisting of only entire male pigs where the large male pigs also are 15 kg and 3 weeks older than the small entire male pigs when they are mixed (Table 1a+b). However the 4 large entire male pigs was slaughtered at 75 kg and left the 4 small entire males alone until slaughter at 100 kg. By doing so the 4 small control entire male pigs were kept as more or less dominant pigs from 60 kg. **See treatment 1 and 3 in the research design in Table 1A+B.**

Dominant female pigs until slaughter of the entire male pigs at 100 kg

A practical way to achieve low rank of male pigs is to mix 4 male pigs with 4 3 weeks older and 15 kg heavier female pigs, when the male pigs on average only weigh 20 kg. This relatively large difference in weight, age and development (physically and socially) ensures the females' achievement of the higher and high rankings. The large difference in initial weight and age at mixing should eliminate the risk of rank changes due to higher growth rate of the male pigs. **See Treatment 2 and 4 in Table 1A+b.**

**Table 1A: Genotype used in Danish outdoor pig production YDxLYD
(YD sire x LYD dam)**

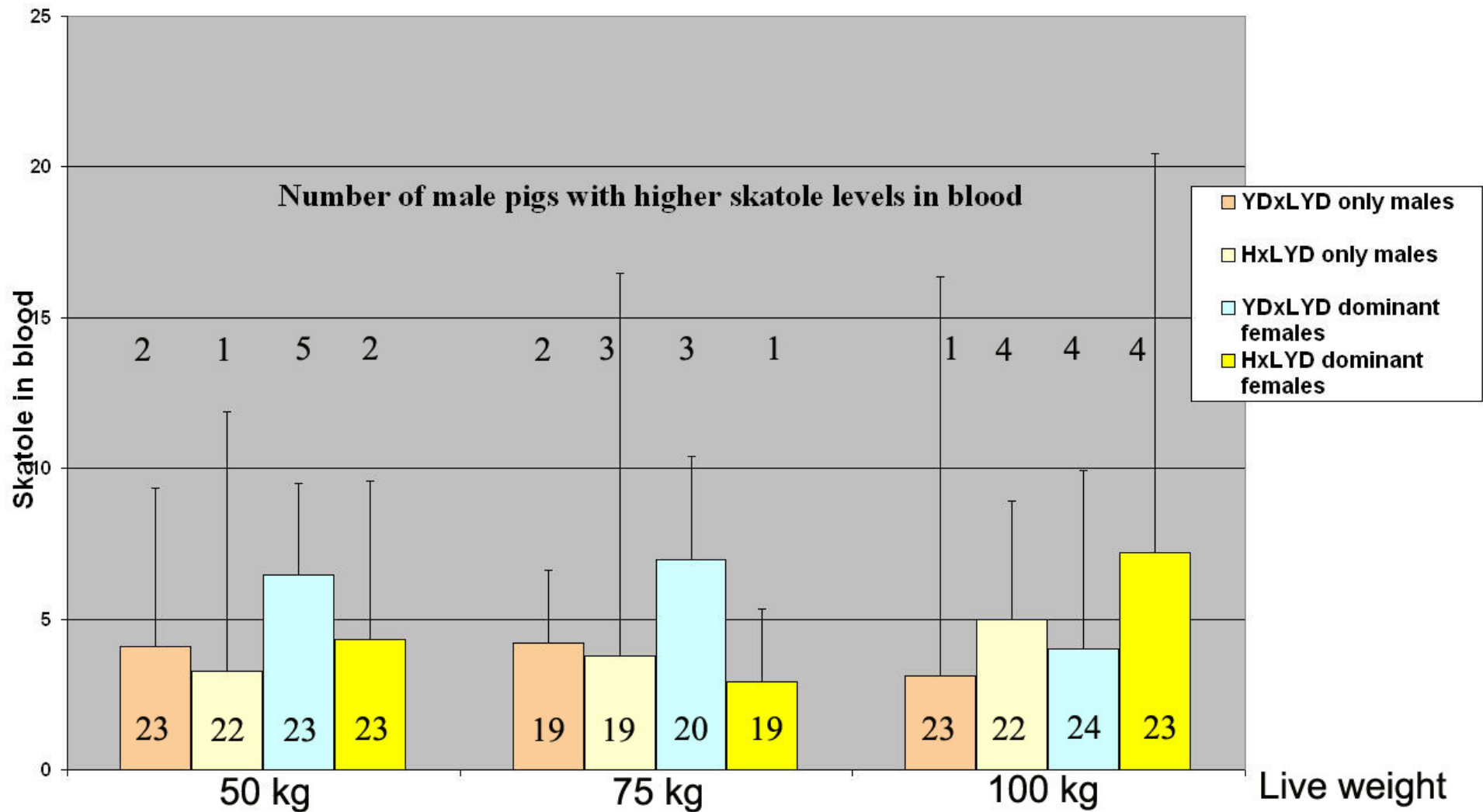
Treatment	Slaughter weight	Slaughter day	Blood samples at different weight (kg) for skatole analysis
<p>1</p> <p>4 small entire male pigs initial weight 20 kg</p> <p>4 big entire male pigs initial weight 35 kg</p>	<p><u>100 kg</u></p> <p><u>75 kg</u></p>	<p>All 4 slaughtered the same day</p> <p>All 4 slaughtered the same day</p>	<p>50 kg 75 kg 100 kg</p> <p>50 kg 75 kg</p>
<p>2</p> <p>4 small entire male pigs initial weight 20 kg</p> <p>4 large female pigs initial weight 35 kg</p>	<p>100 kg</p> <p>115 kg</p>	<p>All 8 slaughtered the same day</p>	<p>50 kg 75 kg 100 kg</p>

**Table 1B: Unusual genotype HxLYD
(Hampshire sire x LYD dam)**

Treatment	Slaughter weight	Slaughter day	Blood samples at different weight (kg) for skatole analysis
3			
4 small entire male pigs initial weight 20 kg	100 kg	All 4 slaughtered the same day	50 kg 75 kg 100 kg
4 big entire male pigs initial weight 35 kg	75 kg	All 4 slaughtered the same day	50 kg 75 kg
4			
4 small entire male pigs initial weight 20 kg	100 kg	All 8 slaughtered the same day	50 kg 75 kg 100 kg
4 large female pigs initial weight 35 kg	115 kg		

Fig. 1

Skatole pattern during the growth period 50 to 100 kg liveweight in entire male pigs (Means +/- Std.)

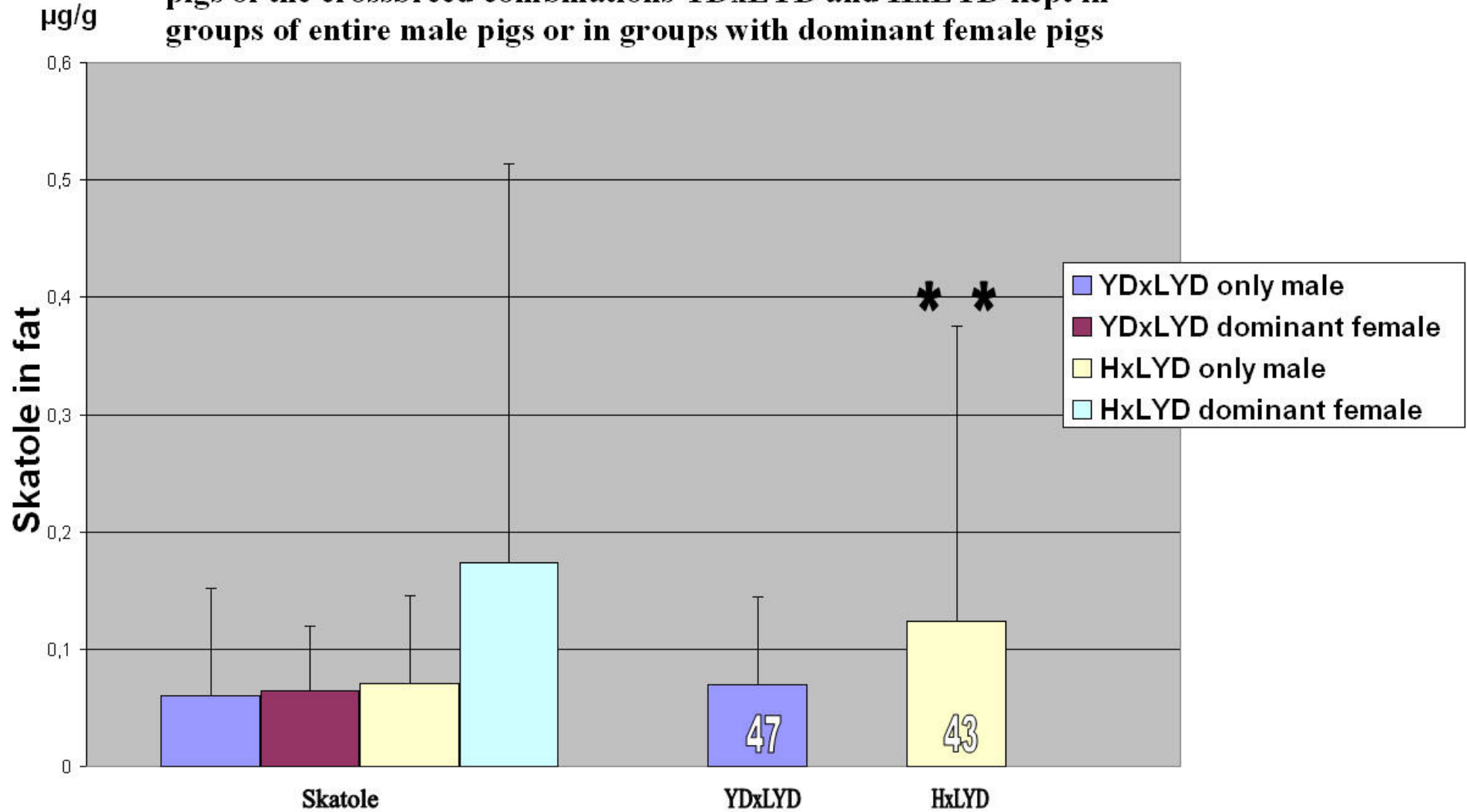


Results

1. Dominant females do not seem to have any decreasing effect on sexual maturity of the smaller entire male pigs as the skatole concentration in blood is not decreased in entire male pigs being dominated during the growth period 50, 75 and 100 kg liveweight (see fig. 1).
2. The amount of entire male pigs having higher skatole concentrations in blood – corresponding to skatole in backfat $> 0.15 \mu\text{g/g}$ – are surprisingly high at 50 kg and 75 kg liveweight compared to 100 kg (10, 9 and 13 entire male pigs).
3. Furthermore it is not the same pigs having high skatole concentrations during the period from 50 over 75 to 100 kg liveweight.
4. The crossbreed YDxLYD seems to have more pigs with higher skatole concentration at 50 kg liveweight, while the crossbreed HxLYD seems to have more pigs with high skatole concentration at 100 kg liveweight.

Fig. 2

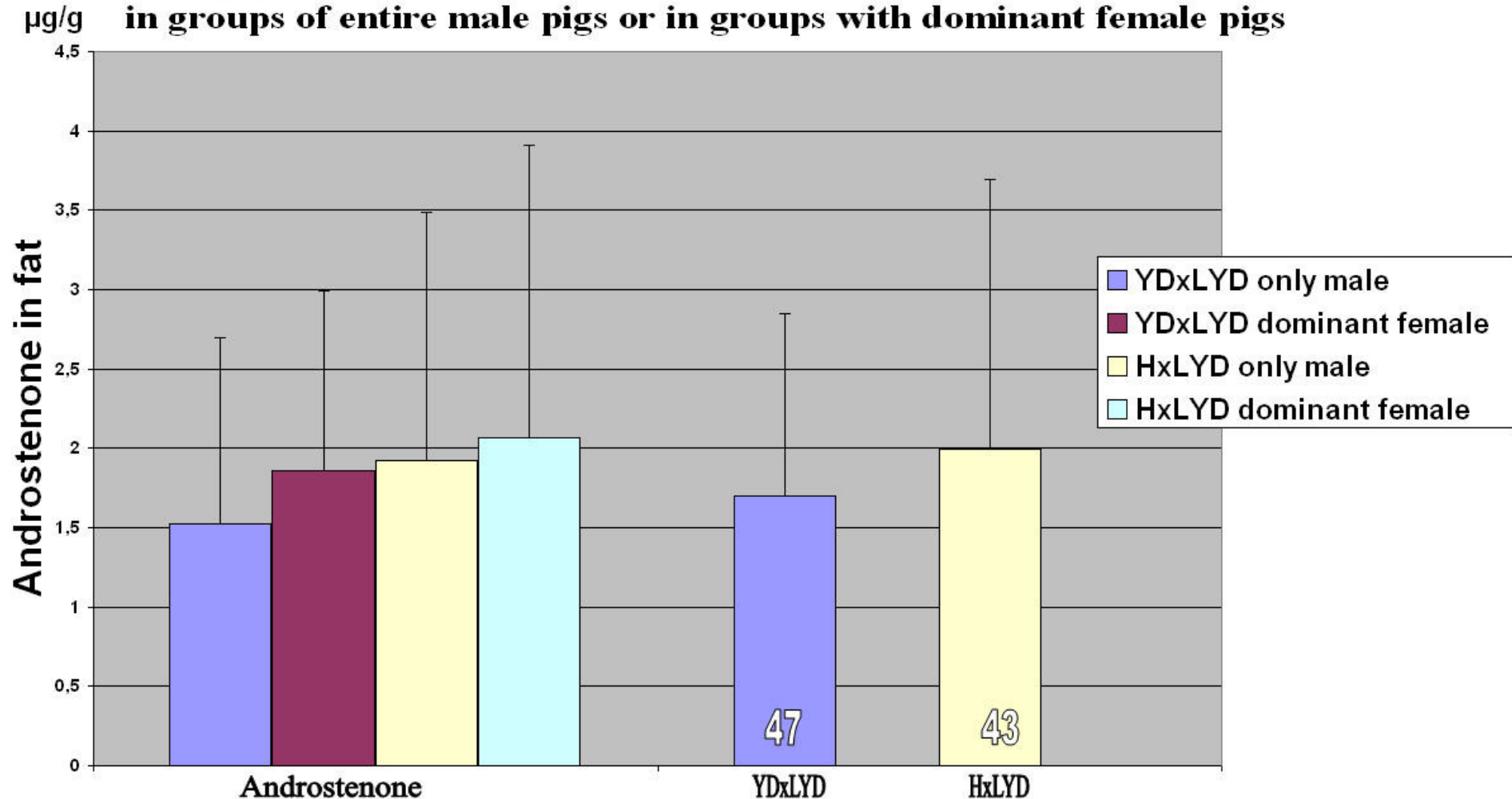
Skatole concentration in backfat at 100 kg liveweight in entire male pigs of the crossbreed combinations YDxLYD and HxLYD kept in groups of entire male pigs or in groups with dominant female pigs



5. The crossbreed HxLYD had significant higher skatole concentration in backfat at slaughter (100 kg liveweight) compared to the crossbreed YDxLYD ($P < 0.05$)(see fig. 2). However, there was no significant difference in androstenone concentration in backfat at 100 kg liveweight between the 2 crossbreeds (see fig. 3).

Fig. 3

Androstenone concentration in backfat at 100 kg liveweight in entire male pigs of the crossbreed combinations YDxLYD and HxLYD kept in groups of entire male pigs or in groups with dominant female pigs



Conclusion

1. Dominant females do not decrease the skatole and androstenone concentration in entire male pigs being dominated during the growth period from 50-100 kg liveweight (see fig. 1 and 3).
2. The amount of entire male pigs having higher skatole concentrations in blood – corresponding to skatole in backfat > 0.15 $\mu\text{g/g}$ – are surprisingly high at 50 kg and 75 kg liveweight compared to 100 kg (10, 9 and 13 entire male pigs).
3. Furthermore it is not the same pigs having high skatole concentrations during the period from 50 over 75 to 100 kg liveweight.
4. The crossbreed HxLYD had significant higher skatole concentration in backfat at slaughter (100 kg liveweight) compared to the crossbreed YDxLYD ($P < 0.05$) (see fig. 2). However, there was no significant difference in androstenone concentration in backfat at 100 kg liveweight between the 2 crossbreeds (see fig. 3).

References

- Babol, J. 1997. Biochemical basis for boar taint. Doctoral thesis. Acta. Swedish University of Agricultural Sciences. Universitatis Agriculturae Sueciae Agraria 42, 40 pp.
- Babol, J., Squires, E.J. and Lundström, K. 1997a. Hepatic metabolism of skatole in pigs by cytochrome P450IIE1. J. Anim. Sci. (In Press).
- Babol, J., Squires, E.J. and Lundström, K. 1997b. Relationship between metabolism of skatole and androstenone. EAAP working group "Production and Utilisation of Meat from Entire Male Pigs", Stockholm meeting, 1-3 October 1997, 4 pp
- Claus, R., Weiler, U. & Herzog, A. 1994. Physiological aspects of androstenone and skatole formation in the boar - A review with experimental data. Meat Science **38**, 289-305.
- Doran, E., Whittington, F. W., Wood, J. D., & McGivan, J. D. 2002. Cytochrome P450IIE1 (CYP2E1) is induced by skatole and this induction is blocked by androstenone in isolated pig hepatocytes. *Chemico-Biological Interactions*, 140(1), 81-92.
- Giersing, M. 1995. Slutrapport vedr. projekt: Indflydelse af opvækstvilkårene på kønslugt hos ukastrede hangrise. J. nr. 703-89-114 og 93S-2466-Å89-00397, 9 pp.
- Giersing, M., Lundström, K. & Andersson, A. 1997. Social effects on boar taint. In: Bonneau, M., Lundström and Malmfors, B (editors) Boar taint in entire male pigs. Proceedings of a meeting of the EAAP working group "Production and Utilisation of Meat from Entire Male Pigs". EAAP Publication No. 92, Stockholm, Sweden, 1-3 October 1997, Wageningen Pers., 108-111.
- Giersing, M., Lundstrom, K., & Andersson, A. (2000). Social effects and boar taint: significance for production of slaughter boars (*Sus scrofa*). *Journal of Animal Science*, 78(2), 296-305.
- Hansen, L.L., Larsen, A.E., Jensen, B.B. & Hansen-Møller, J., 1997a. Short time effect of Zinc bacitracin and heavy fouling with faeces plus urine on boar taint in male pigs. *Animal Science* **64**, 151- 163.
- Hansen, L.L., Lundström, K., Laue, A., Jensen, M.T., Agergaard, N., Bæk, C.Æ. & Hansen-Møller, J. 1997b. Skatole and androstenone pattern during the growth period from 90 to 120 kg live weight in pigs with high or low skatole levels in back fat at slaughter. In: Bonneau, M., Lundström and Malmfors, B (editors) Boar taint in entire male pigs. Proceedings of a meeting of the EAAP working group "Production and Utilisation of Meat from Entire Male Pigs". EAAP Publication No. 92, Stockholm, Sweden, 1-3 October 1997, Wageningen Pers., 131-134.
- Jonsson, P., 1985. Gene action and maternal effects on social rank and its relationship with production traits in pigs. *Zeitschrift für Tierzüchtung und Züchtungsbiologie* **102**, 3, 208-220.
- Jonsson, P. & Jørgensen, J.N. 1988. Social rank in pigs and its relation to production traits including androstenone in boar fat. *World Review of Animal Production* **24**, no. 2, April-June, 85-89.
- Neupert, B., Claus, R., Herbert, E. and Weiler, U. 1995. Einfluss von Geschlecht, Fütterung und Lichtprogrammen auf Mastleistung und Schlachtkörperwert sowie die Androstenon- und Skatolbildung beim Schwein. *Züchtungskunde* **67**, 317-331.
- Ruschen, J. 1987. A difference in weight reduces fighting when unacquainted newly weaned pigs first meet. *Can. J. Anim. Sci.* **67**, 951-960.
- Sorensen, D. & Pedersen, B., 1994. Skatoltallets arvelighed. Landsudvalget for Svin. Danske Slagterier, Axelborg. Rapport, 5 pp.
- Squires, E.J. & Lou, Y., 1995. Levels of boar taint in purebred entire male pigs in Canada. Meeting of the EAAP working group "Production and Utilization of Meat from Entire Male Pigs", Milton Keynes, 27-29 September 1995, 5 pp.