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THE EFFECT OF ANDROSTENEDIONE ON GROWTH, CARCASS COMPOSITION AND REPRODUCTIVE DEVELOPMENT OF PORKERS

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OPSOMMING: INVLOED VAN ANDROSTENEDIONE OP DIE GROEI, KARKASSAMESTELLING EN REPRODUKTIEWE ONTWIKKELING VAN VARKE

'n Reeks proewe is uitgevoer om die effek van die steroïd hormoon androstenedione op die groeivermoë en karkassamestelling van jong groeiende varke, ingespuit vanaf speenouderdom totdat hulle op 'n lewendige gewig van 45 kg geslag is, te bepaal. Die resultate dui daarop dat androstenedione wel 'n groeistimulerende effek op jong varke het. Die jong soggie reageer nie goed op behandeling nie maar die beertjie groei betekenisvol vinniger as die onbehandelde beertjie met 'n beter karkas maar met onderdrukte geslagsontwikkeling. Dit blyk verder dat die testis belangrik is in die verkryging van maksimum voordele uit androstenedione inspuitings.

SUMMARY

A series of experiments were carried out to determine the effects of the steroid hormone androstenedione on the growth and carcass composition of growing pigs injected from weaning to porker weight (45 kg). The results indicated that androstenedione had a growth stimulating effect on the young pig. The young gilt did not react favourably to treatment but young boars grew significantly faster than untreated boars with a better carcass and suppressed sexual development. It would appear that the testis plays an important rôle in obtaining maximum advantages from androstenedione injections.

It is well known that the intact male grows faster than the castrated male on a high plane of nutrition (Turton, 1962). It has also been found that the testicular steroid androstenedione had an anabolic effect on the growth of bull calves while suppressing reproductive development (Skinner, Mann & Rowson, 1968). Moreover, a similar effect was established in young boars during a pilot study (Skinner, Kemm & Pieterse, 1968). The object of the present series of experiments was to expand on the pilot study and establish whether additional weight gain and a change in carcass composition could be obtained by injecting pigs from weaning until they reached 45 kg liveweight with the steroid hormone, androstenedione.

Procedure

Experiment 1

Eighteen Landrace pigs, nine gilts and nine barrows were divided into three equal groups according to weight and sex at weaning (8 weeks); two groups were injected intramuscularly with androstenedione, Group A at the rate of 2 mg/5 kg body weight and Group B at the rate of 10 mg/5 kg body weight while Group C was injected with 1,0 ml arachis oil only. The pigs were injected three times per week, the dose rate being determined from the weekly weights. The pigs were fed *ad lib* on a balanced diet consisting of 18% crude protein and 79,7 % digestible energy.

As soon as the pigs reached a liveweight of 45 kg they were slaughtered, hung in a refrigerated room for 48 hours and then weighed. The carcasses were then split medially and the right side used for carcass measurements according to the method of Kemm, Pieterse, Griessel & Mammes (1971). The results were analysed by the analysis of variance or Students t test.

Results and Discussion of Experiment 1

The main results of the experiment are illustrated in Tables 1 and 2.

It can be seen that there was no noteworthy difference between the different treatment groups. The pigs on the high level of androstenedione achieved the poorest average daily gain (ADG) and had the thinnest backfat. These results are in agreement with those of Hale & Johnson (1970) who found that a high level of methyltestosterone when administered to pigs resulted in a lower ADG, feed intake and backfat thickness. If the results for the two sexes are considered alone it is apparent that there was little difference between the gilts in the different groups. Szumowski & Theret (1970) also found that hormone treatment had little effect on gilts. On the other hand, a too high level of androstenedione treatment appeared to suppress growth in the barrows. In addition, they developed rough patches on the skin. However, only small numbers of animals were involved and these results can therefore not be regarded as conclusive.

Experiment 2

Four Landrace barrows with an average weight of 47 kg were divided into three groups, two barrows in group A and one each in groups B and C. Each barrow received 1 kg of feed (18,1% crude protein and 79,7 % digestible energy) twice per day. The barrows were treated in three different ways and each treatment was repeated three times so that each group was exposed to each treatment only once. In Treatment 1 the barrows were injected intramuscularly with 2 mg androstenedione per 5 kg body weight three times per week; in Treatment II 10 mg androstenedione per 5 kg body weight three times per week and in

Table 1

Comparison between pigs in the different treatment groups.

Group	A	B	C
No	6	6	6
Commencing weight (kg)	16,41 ± 3,85	16,75 ± 3,13	16,95 ± 2,59
Slaughter weight (kg)	43,91 ± 1,25	44,54 ± 0,47	45,63 ± 2,13
ADG (kg/day)	0,47 ± 0,05	0,45 ± 0,04	0,48 ± 0,05
Feed conversion (kg feed/kg wt gain)	2,54 ± 0,15	2,57 ± 0,36	2,55 ± 0,11
Dressing percentage	74,6 ± 1,76	74,6 ± 2,98	75,3 ± 2,16
Carcass length (cm)	69,0 ± 1,2	68,3 ± 1,9	69,6 ± 1,2
Av. Backfat thickness (cm)	1,46 ± 0,12	1,34 ± 0,72	1,48 ± 0,19
Av. C & K measurement (cm)	0,91 ± 0,23	0,82 ± 0,14	1,01 ± 0,18
Eye muscle surface area (sq. cm)	23,9 ± 1,3	25,6 ± 5,2	24,4 ± 5,2

Table 2

Comparison between barrows and gilts

	Gilts			Barrows		
Groups	A	B	C	A	B	C
No.	3	3	3	3	3	3
ADG (kg/day)	0,47	0,47	0,49	0,47	0,42	0,47
Feed conversion (kg/feed/kg wt. gain)	2,51	2,47	2,53	2,57	2,66	2,59
Carcass length (cm)	69,4	67,7	69,6	68,6	68,8	69,5
Av. Backfat thickness (cm)	1,41	1,41	1,46	1,51	1,27	1,51
Av. C & K measurement (cm)	0,9	0,93	1,05	0,92	0,7	0,97

Treatment III 1 ml arachis oil – the controls. Each treatment lasted for two weeks and during the final six days the pigs were placed in metabolism crates. The first day served as an adjustment period while faeces and urine were collected for the following five days. The wet faeces were weighed and then dried in an oven to calculate the percentage dry matter (% DM) and the total dry matter (TDM). The urine was treated with concentrated hydrochloric acid and the nitrogen in both faeces and urine determined by the Kjehldahl method. The feed intake of the pigs was also measured over the five days they were in the crates.

Results and discussion of Experiment 2

The results are illustrated in Table 3.

In calves the anabolic effect of hormones results from their ability to stimulate growth, nitrogen retention and protein deposition (Baronos, Mann, Rowson & Skinner, 1969). In this experiment the results indicated that there was a tendency for higher nitrogen retention by the androstenedione treated pigs which is a reflection of increased protein deposition and agrees with the results of Baronos *et al.* (1969) on the bull calf.

Experiment 3

Thirty two Landrace boars were used in this experiment. They were divided into four groups of eight according to weight and litter of origin. Groups A and B were injected intramuscularly with 1 mg androstenedione per 1 kg body weight three times per week while Groups C and D served as controls and were only injected with oil. The boars in Groups A and D were castrated. The pigs were fed *ad lib* a concentrate ration containing 18,1% crude protein and 79,7 % digestible energy. The feed intake was measured. They were weighed weekly and the ADG and feed conversion rate calculated.

When the pigs reached a weight of 45 kg they were slaughtered and the carcasses treated in the same manner as in Experiment 1. Three rib cuts (Hankins & Howe, 1946) were also taken and the amount of muscle, fat and bone dissected out. At slaughter, the reproductive tracts of the boars were dissected out, weighed, pieces taken for histology and the vesicular fructose concentration determined (Lindner & Mann, 1960). The histological sections were fixed in Bouin's or Zenker-formol solution. After routine paraffin embedding and sectioning at 6 μ, the former were stained with Delafield's haematoxylin and

Table 3

Nitrogen balance in treated and untreated pigs

	D.M. Intake g/day	N intake	D.M. excreted g/day	N in faeces	N in urine	Total N excreted	N Balance
2 mg androst*	1652	47,7	251,4	6,64	24,7	31,34	16,36
10 mg androst*	1617	46,7	246,0	6,51	24,1	30,6	16,1
Control	1642	47,4	261,0	7,02	25,1	32,1	15,3

* Four pigs per treatment.

Table 4

Comparison between treated and untreated groups of pigs

	Androstenedione treated		Control	
	A (castrates)	B (boars)	C (boars)	D (castrates)
No	8	8	8	8
Commencing weight (kg)	14,3 ± 3,1	13,7 ± 3,1	13,7 ± 3,3	13,6 ± 3,2
Slaughter weight (kg)	44,6 ± 1,77	43,4 ± 1,06	43,2 ± 1,82	43,5 ± 1,45
No. of days fed/pig	55,0 ± 11,3	55,0 ± 9,8	60,0 ± 11.3	63,0 ± 13,2
** ADG (kg/day)	0,56 ± 0,02	0,54 ± 0,02	0,50 ± 0,02	0,48 ± 0,02
Feed conversion (kg feed/kg wt gain)	2,53	2,53	2,63	2,63
Dressing percentage	71,3 ± 2,1	71,0 ± 2,0	71,3 ± 2,1	70,0 ± 2,2
Carcass length (cm)	68,8 ± 1,5	67,6 ± 0,9	69.0 ± 1,6	68,2 ± 1,3
Av. Backfat thickness (cm)	2,0 ± 0,2	1,8 ± 0,1	1,7 ± 0,2	1,9 ± 0,2
Av. C & K measurement (cm)	1,3 ± 0,08	1,1 ± 0,09	1,1 ± 0,20	1,2 ± 0,12
Eye muscle surface area (sq cm)	13,5 ± 2,8	14,4 ± 1,8	13,6 ± 1,4	12,6 ± 1,8
** Eye muscle mass (surf. area x carcass length)	930,2 ± 64,3	973,4 ± 120,4	938,4 ± 92,9	859,3 ± 117,7
* Fat % in three rib cut	42,0 ± 0,8	37,7 ± 2,3	38,9 ± 3,0	40,0 ± 2,8
Muscle % in three rib cut	45,1 ± 1,7	47,4 ± 2,7	47,8 ± 3,1	47,3 ± 2,4
Bone % in three rib cut	11,2 ± 2,2	12,6 ± 2,0	11,3 ± 1,9	11,4 ± 1,7
** Testes wt (g)		51,6 ± 4,9	75,2 ± 19,4	
** Seminiferous tube diameter (μ)		79,7 ± 11,5	100,3 ± 28,0	
** Epididymes wt (g)		17,9 ± 1,3	20,6 ± 2,5	
** Vesiculae seminalis { wt (g)	1,5 ± 0,2	10,3 ± 1,6	13,0 ± 5,8	1,3 ± 0,2
** Vesiculae seminalis { Fructose (mg/100g)	0,0	21,2 ± 9,4	31,4 ± 11,8	0,0
** Bulbo-urethrals weight (g)	2,5 ± 0,4	18,0 ± 7,1	22,6 ± 7,1	2,4 ± 0,5

* Statistically significant at $P < 0,05$

** Statistically significant at $P < 0,01$

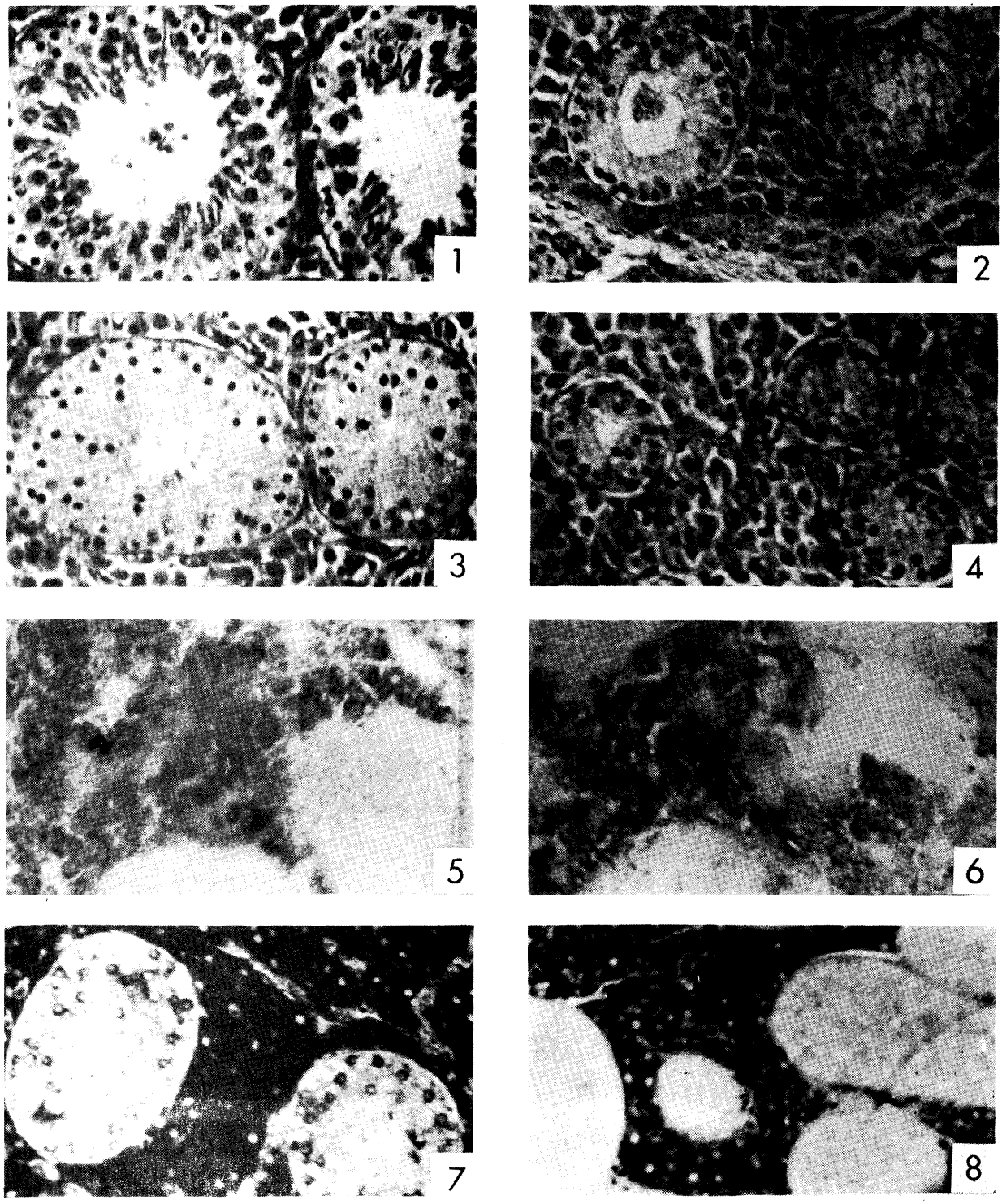

Plate 1

Sections of testes from Landrace pigs at 45 kg bodyweight. Figs. 1, 2, 3 and 4 stained with Delafields haematoxylin and chromotrope 2R. Figs. 5 and 6 unfixed frozen sections incubated for 3 hr to demonstrate Δ^5 – 3 β– hydroxysteroid dehydrogenase activity. Figs. 7 and 8 stained with Sudan Black to show interstitial cells. x256.

Figs. 1 and 3 *testes from untreated boars showing the range of testicular development from full spermatogenesis (1) to primary spermatocytes (3).*

Figs. 2 and 4 *testes from androstenedione treated boars showing the range of testicular development from primary spermatocytes (2) to gonocytes (4).*

Figs. 5 and 6 *Δ^5 3 β – hydroxysteroid dehydrogenase activity in the interstitium. Note the greater amount of activity in the control testis (5) than in the treated testis (6).*

Figs. 7 and 8 *Sudan Black staining of the interstitium. Note the greater amount of lipid present in the control testis (7) than in the treated testis (8).*

chromotrope 2 R and the latter with Sudan black according to Threadgold (1957) in his method 1. Pieces of testis were also frozen onto cyrostat chucks, sectioned at 16 µ, incubated for three hours according to the method of Hay & Deane (1966) to demonstrate $\Delta^5 - 3\beta$ - hydroxysteroid dehydrogenase in the interstitium.

Results and discussion of Experiment 3

The results are illustrated in Table 4 and Plate 1.

From Table 4 it is evident that the treated boars had a better ADG than their untreated counterparts and took less time to reach a weight of 45 kg ($P<0,01$). They also deposited less fat, ($P<0,05$), but about the same percentage of muscle ($P<0,01$). The weight of the reproductive organs of the treated boars was significantly lighter ($P<0,01$), the concentration of vesicular fructose was less ($P<0,01$) and the seminiferous tubule diameter was smaller ($P<0,01$). Histologically, all sections showed signs of spermatogenesis except those from two treated boars (Plate 1, Figs. 1, 2, 3 & 4) and development of the interstitial cells was suppressed in the treated boars (Plate 1, Figs. 5, 6, 7 & 8). Reproductive development was suppressed in all the treated boars which is in agreement with earlier results on the bull calf (Skinner, *et al.* 1968).

Comparing the results from the treated and untreated barrows, it is apparent that, although the treated group had a better ADG and feed conversion rate, they also tended to lay down more fat with less muscle development. This lowers the advantage of androstenedione treatment to castrated pigs.

Conclusions

The results of these experiments indicate that androstenedione has, under certain conditions, an anabolic effect on young pigs. The gilt does not respond well to treatment but the treated boar is superior to his untreated counterpart showing a significantly higher growth rate, a better carcass, but suppressed reproductive development. It would appear that the testis is important in deriving maximum benefit from androstenedione injections. Further research should be directed to: (1) establishing a more practical method of treating boars (e.g. via the feed); (2) the value of treating the runts in the litter, thereby eliminating them; (3) treating boars to baconer weight (90 kg); (4) the effect on pork taint; (5) the mode of action and the pathways of the injected androstenedione should be determined.

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