Acta vet. scand. 1979, *20*, 276—288.

From the Department for Experiments with Pigs and Horses, National Institute of Animal Science, Copenhagen, the Institute of Internal Medicine and the Department for Anatomical Pathology, Royal Veterinary and Agricultural University, Copenhagen, the Risø National Laboratory, Roskilde, and the Division of Chemical Determination of Nutrients, National Food Institute, Søborg, Denmark.

SELENIUM AND VITAMIN E DEFICIENCY IN PIGS

I. INFLUENCE ON GROWTH AND REPRODUCTION

By

H. E. Nielsen, V. Danielsen, M. G. Simesen, G. Gissel-Nielsen, W. Hjarde, T. Leth and *A. Basse*

NIELSEN, H. E., V. DANIELSEN, M. G. SIMESEN, G. GISSEL-NIELSEN, W. HJARDE, T. LETH and A. BASSE: *Selenium and vitamin E deficiency in pigs. I. Influence on growth and reproduction.* Acta vet. scand. 1979, *20*, 276—288. — The effect of selenium (Se) and vitamin E (Vit. E) on reproductive performance, growth and health was studied in pigs. Two levels of Se were used, 0.03 and 0.06 mg per kg feed. The major component of the experimental diets was barley originating from soil which had formerly produced crops with a very low content of Se. Prior to seeding, the area was divided into 2 plots, 1 of which was treated with Se in the form of sodium selenite, 100 g Se per ha. The use of Se enriched fertilizer was an effective way of increasing the Se concentration of the grain. Thus the concentration of Se in the barley produced on the treated area was 5 times higher than in barley from the untreated one.

Vit. E was added at a level of 30 i.u. per kg feed, and the concentrations were approx. 15 and 45 i.u. in the basal and experimental diets, respectively.

The higher level of Se or Vit. E was not significantly associated with milk yield of the sow, litter size, birth weight or haemoglobin levels. However, there was a tendency to an increase in milk yield of the sows following additions of Se plus Vit. E, and litter size was slightly higher from sows which had received an addition of Vit. E. The concentration of Se and Vit. E was much higher in colostrum than in sow milk, and additions of dietary Se and Vit. E were associated with marked increases in the concentrations of these compounds in both colostrum and sow milk. There was a moderately improving effect of a high Se concentration in feed on growth rate and feed utilization. Low dietary levels of Se and Vit. E were followed by increased mortality rate in piglets; iron toxicity in connection with iron treatment was observed in piglets on low dietary Vit. E. Symptoms characteristic of PSE were not observed in the Se and Vit. E deficient pigs.

selenium; vitamin E; hepatosis dietetica; mulberry heart disease; growth; reproduction; pigs.

In the past 20 years, spontaneous outbreaks of Se/Vit. E deficiency in pigs have been reported in several countries, e.g. USA (*Michel et al.* 1969, *Trapp et al.* 1970, *Mahan et al.* 1973), New Zealand (*Hartley & Grant* 1961, *Andrews et al.* 1968), Sweden (*Lannek et al.* 1960), Austria (*Hasitschka & Hasitschka* 1973) and Denmark (*Gissel-Nielsen* 1972). The Se deficient pigs showed one or more of the following symptoms: Sudden deaths among fast growing animals associated with hepatic necrosis (hepatosis dietetica), cardiac muscular degeneration or microangiopathy (mulberry heart disease) and degeneration of skeletal muscles (*Grant* 1961).

The number of outbreaks of diseases caused by Se/Vit. E deficiency have been increasing due to low and decreasing concentrations of Se in some animal feeds (*Gardiner et al.* 1961, *Kubota et al.* 1967, *Gissel-Nielsen* 1972).

In this study the effects on growth and reproduction in pigs of 2 levels of dietary Se were investigated with and without addition of Vit. E. Furthermore, the effect of dietary Se on the concentration of Se and Vit. E in sow colostrum and milk was studied.

MATERIAL AND METHODS

The experimental design can be seen in Table 1. Sixty piglets, 28 castrated males and 32 females, were weaned at 3 weeks of age and distributed in the 4 experimental groups. They were reared in individual pens to approx. 85 kg live weight. The males were then slaughtered, and performance data compilation and carcass assessments were undertaken (1st generation).

The female pigs remained in the respective experimental groups and were mated at the first oestrus after 7 months of age. Two sows from each group were selected for further mating. They remained in their experimental group for a total of 4 litters each, or until they were eventually culled.

The number of sows and litters involved in the experiment and the indication for culling are shown in Table 2. Concentrations of Se and Vit. E in colostrum were determined from a sample drawn immediately after farrowing. Each sample was analysed for Se in duplicate using the fluorometric method described by *Olson* (1969) and modified by *Gissel-Nielsen* (1977). Determination of Vit. E was carried out according to *Hjarde et al.* (1973). Dry matter, protein, fat, Se and Vit. E in the milk were

Table 1. Experimental design.

	Group			
	1	2	3	4
Se in feed	low	low	high	high
Se concentration mg/kg[1]	0.03	0.03	0.06	0.06
Vit. E suppl. i.u./kg	0	30	0	30
Vit. E concentration i.u./kg	15	45	15	45
Number of pigs:				
At start of trial (3 weeks old)	15	15	15	15
Females for breeding	8	8	8	8
Male pigs slaughtered at 85 kg live weight:				
1st generation	7	7	7	7
2nd generation	38	44	42	41

[1] Estimated average dietary Se concentration for the entire experimental period based on Se determinations of the components of the experimental rations.

estimated by analysing a sample drawn in the second week of lactation. Colostrum and milk samples were collected by milking about 10 ml by hand after an injection of 0.4 ml oxytocin in an ear vein. The milk yields of the sows were estimated by weighing the whole litter before and after 6 successive sucklings. Daily milk yields for the sows were calculated on the basis of the weight gain of the piglets at each suckling.

Table 2. Sows in the trial groups.

Group	1	2	3	4
Se in feed	low	low	high	high
Vit. E suppl.	0	+	0	+
Number of female pigs	8	8	8	8
Number of sows, 1st litter	5	7	4	5
Number of sows, 2nd litter	1	1	2	2
Number of sows, 3rd litter	1	1	2	1
Number of sows, 4th litter	1	1	2	1
Total number of litters	8	10	10	9
Reason for exclusion:				
Anoestrus	1	1	0	1
Absence of pregnancy	3	1	2	0
Miscellaneous	3	5	4	6

The weight of the piglets was recorded at birth and at weaning (1st generation at 3 weeks, 2nd generation at 8 weeks of age). The haemoglobin levels of all piglets were measured at birth and at 3 and 8 weeks of age. All piglets received an injection of 2 ml iron dextran at 3 days of age.

A total of 165 piglets were selected for further tests for the period from 8 weeks of age to approx. 85 kg live weight (2nd generation). After slaughter the carcasses were assessed for meatiness, and the meat colour and KK-index* were determined according to *Pedersen* (1977).

The major component of the experimental diets was barley grown in soil which had formerly produced crops with a very low content of Se. Prior to seeding the area was divided into 2 plots, 1 of which was treated with Se in the form of sodium selenite at a level of 100 g of Se per ha. During the experiment the diets were slightly changed by adding 2 % of lard. Hot air had been blown through the fat to increase the concentration of peroxides and thus the demand for Vit. E. For 2nd-litter piglets herring oil was given from the age of 8 weeks to about 50 kg live weight. Table 3 shows the composition of the experimental rations. The diets marked I were those fed before the oxidized lard was used, and diets marked II were those fed after addition of

Table 3. Experimental diets.

	Piglets		Growing pigs		Sows	
Diet:	I	II	I	II	I	II
Barley	63.8	69.6	80.8	78.8	80.5	78.7
Soybean meal	10.0	10.0	6.0	6.0	9.0	9.0
Skim milk powder	5.0	5.0	0	0	0	0
Protein concentrate (yeast)	12.0	7.0	9.0	9.0	6.0	6.0
Lard	2.0	2.0	0	2.0	0	2.0
Sugar	3.0	3.0	0	0	0	0
Lysine/methionine mixt.	0.9	0	1.0	1.0	1.0	1.0
Mineral, vit. + trace mineral mixt.	3.3	3.4	3.2	3.2	3.5	3.3
Dig. crude protein, g/kg	140	140	131	130	126	125
Lysine, g/kg	7.5	7.5	7.8	7.8	6.7	6.7
Methionine + cystine, g/kg	5.2	5.2	6.2	6.1	5.3	5.2

* KK-index = meat quality index.

oxidized lard. The diets were offered ad libitum until 8 weeks of age. After 8 weeks, all experimental animals remained in their experimental group and were subjected to restricted feedings, 0.8 to 3.2 kg feed/pig, on a diet for growing pigs.

RESULTS

The use of sodium selenite as fertilizer, 100 g Se as sodium selenite per ha, increased the content of Se in the barley from 0.01 p.p.m. to 0.05 p.p.m.

Reproduction

As can be seen from Table 4 the number of liveborn pigs and the number of pigs alive at 8 weeks were lower for sows in Groups 1 and 3 than for sows in the other groups. The individual body weight of piglets was lowest for Group 2. However, none of these differences were statistically significant. Only insignificant differences were observed for haemoglobin concentration in the blood of the piglets.

Table 4. Reproductive performance of sows.

	Group				s.e.m.	Significance levels
	1	2	3	4		
Number of pigs per litter:						
Total	10.4	10.4	9.2	9.9	0.7	NS*
Liveborn	9.4	10.2	8.6	9.7	0.7	NS
At 8 weeks	7.8	8.9	6.7	8.8	0.7	NS
Mortality, %	17	13	22	9	4	NS
Av. weight, kg:						
At birth	1.5	1.3	1.4	1.5	0.1	NS
At 8 weeks	17.4	14.8	17.7	17.2	0.6	NS
Haemoglobin level in blood, g %						
At birth	10.4	10.8	10.9	10.3	0.5	NS
At 3 weeks	10.9	11.9	11.4	11.1	0.5	NS
At 8 weeks	12.2	12.1	11.8	12.0	0.6	NS
Estimated milk yield per sow, daily, kg:						
1st week	3.7	3.3	3.0	3.9	0.5	NS
2nd week	5.6	5.3	4.9	5.8	0.5	NS
3rd week	6.1	5.4	5.4	6.9	0.6	NS

* In this and subsequent tables: NS = $P > 0.05$.

None of the differences in milk yield and milk composition were statistically significant, although there was a tendency to a lower milk yield for Group 3.

The concentration of Se and Vit. E in colostrum and milk can be seen in Table 5. The concentration of Se as well as Vit. E is much higher in colostrum than in milk.

Table 5. Contents of Se and Vit. E in colostrum and milk.

	Group			
	1	2	3	4
Se colostrum µg/kg	55	53	105	108
Se milk µg/kg	14	13	26	27
Vit. E colostrum mg/kg	6	22	5	22
Vit. E milk mg/kg	1	2	1	3

Growth

Tables 6 and 7 show the weight gain, feed conversion and KK-index for the pigs tested from 3 weeks of age to approx. 85 kg live weight for 1st generation and from 8 weeks of age to approx. 85 kg 2nd generation, respectively. The difference between groups in regard to weight gain was statistically significant. The cross-section area of m. long. dorsi was significantly greater for pigs on low Se-ration (Table 7).

Table 6. Performance and meat production of pigs fed different levels of Se and Vit. E from 3 weeks of age to slaughter at approx. 85 kg live weight (1st generation).

	Group				s.e.m.	Significance levels
	1	2	3	4		
Number of pigs	15	15	15	15		
Average daily weight gain, g	462	486	487	467	7	0.05
Kg feed per kg weight gain	3.08	3.13	3.04	3.15	0.04	NS***
Area of m. long. dorsi, cm^2*	31.6	33.7	31.6	33.1	0.6	NS
KK-index**	8.3	7.5	7.6	7.5	0.2	NS
Number of deaths	1	1	0	2		

* Only 7 pigs per treatment.
** KK-index = meat quality index.
*** See Table 4.

Table 7. Performance and meat production of pigs fed different levels of Se and Vit. E from 8 weeks of age to slaughter at approx. 85 kg live weight (2nd generation).

	Group				s.e.m.	Significance levels
	1	2	3	4		
Number of pigs	38	44	42	41		
Average daily weight gain, g	585	561	610	595	7	0.01
Kg feed per kg weight gain	3.06	3.07	2.96	2.96	0.03	0.01
Chilled carcass weight, kg	60.5	60.0	60.0	59.8	0.3	NS*
Area of m. long. dorsi, cm^2	33.3	33.1	32.4	32.4	0.1	0.01
KK-index	7.7	7.7	7.7	7.5	1.5	NS
Number of deaths	3	3	0	0		

* See Table 4.

DISCUSSION

In spite of the relatively small number of animals in the experiment, it may be concluded that litter size at birth and weaning was numerically but not significantly higher for the groups which received additional Vit. E (Groups 2 and 4).

Three of the piglets in Group 3 died immediately after having received a booster injection of iron dextran. This finding is in accordance with observations by *Tollerz* (1973) that the tolerance of piglets to iron injections increased with increased dietary levels of Vit. E.

The estimated daily milk yield per sow is in good agreement with earlier studies in the same herd. However, they are lower than comparable figures reported by *Onderscheka* (1969). There was a slight trend towards a higher milk yield for sows in Group 4, receiving the highest dietary level of Se and Vit. E. For sows on low levels of Vit. E, *Nielsen et al.* (1973) observed a drastic drop in milk yield. In these studies, however, the deficiency was more pronounced than in the present work.

Increased levels of Se or Vit. E in the diet for sows was associated with a marked increase in the levels of these compounds in colostrum and milk. The levels of Se in colostrum are in good agreement with *Rasmussen* (1974 b) and *Young et al.* (1977). *Rasmussen* (1974 b) found a slight decrease in the concentration of Se from 10 to 21 days after farrowing. The data in Table 5 refer to milk samples drawn approx. 10 days post partum. The

Se concentrations were slightly lower than the figures given by *Rasmussen* (1974 b), but the dietary levels of Se in this experiment were also lower. Levels of Vit. E in colostrum of unsupplemented sows are comparable to those reported by *Young et al.* but are somewhat higher than those reported by *Nielsen et al.* However, in the latter study there was a pronounced Vit. E deficiency.

The majority of investigations employing the levels of dietary Se referred to here, did not reveal significant effects on growth rate and feed utilization (*Ewan et al.* 1969, *Groce et al.* 1971, *Ullrey* 1971, *Wastell et al.* 1972, *Rasmussen* 1974 a). In the present investigation an increase in the Se concentration from 0.03 to 0.06 mg per kg feed had a small but significantly positive effect on the growth rate, and caused a reduction in feed requirements per kg gain. No such effect was observed from additions of Vit. E to the basal diet. *Piper et al.* (1975), however, have demonstrated a significant effect on growth rate and feed utilization of supplemental Se and/or Vit. E to a diet based on peas. This diet contained 0.06 mg Se and 7.0 i.u. Vit. E per kg. *Wastell et al.* found that pigs on a basal torula yeast diet, containing 0.04 mg Se per kg, supplemented with either 136 i.u. Vit. E or 0.5 mg Se per kg, had a significantly lower growth rate and inferior feed conversion ratio than pigs given both supplements.

In the present investigation 0.03 mg Se per kg did not prevent deaths, regardless of the Vit. E dietary level. Other investigators have reported deaths among pigs receiving low levels of dietary Se and Vit. E. In most cases losses could be prevented by Se and/or Vit. E supplementation (*Ewan et al., Ewan* 1971, *Groce et al., Piper et al.*). *Ullrey*, on the other hand, did not report increased mortality in groups fed basal rations containing 0.04—0.05 mg Se per kg. The lack of complete agreement between the reported results may be due to differences in the overall Se and Vit. E status of the pigs. However, also genetically determined differences in the requirement of this nutrient should be considered (*Jørgensen et al.* 1977).

For several carcass characteristics, *Thomke et al.* (1965) found no differences between control pigs and groups given 0.2 mg Se or 25 i.u. Vit. E per kg diet or both. In the present experiment no significant difference was observed in the area of m. long. dorsi in the first generation of pigs, whereas in the second generation the area of m. long. dorsi was smallest for pigs receiving the highest concentration of Se.

Only limited information is available on the effect of dietary Se concentrations on the organoleptic quality of pig meat. *Ludvigsen* (1964) found a higher score for meat colour in pigs from Se supplemented groups as compared with unsupplemented pigs. For several meat quality traits, *Thomke et al.* found no difference between control pigs and pigs given 0.2 mg additional Se per kg diet. These workers emphasized that the Se-Vit. E deficiency syndrome is completely different from the PSE-complex*. This is in agreement with *Froseth* (1979) who observed signs of Se-Vit. E deficiency in pigs fed a basal diet containing 0.06 mg Se and 7.0 i.u. α-tocopherol per kg feed, and there was no evidence that this deficiency was related to the PSE-complex. Further support for this interpretation has been published by *Biering-Sørensen* (1976 a, b) who described the histological ultrastructural and biochemical changes connected with PSE. He stated that these changes are different from the changes seen in degenerated muscles. A detailed description of ultrastructural alteration in skeletal muscle of pigs suffering from Se-Vit. E deficiency has been given by *Van Vleet et al.* (1976) who stressed the relationship between the biochemical scheme for the function of Vit. E and Se, as described by *Hoekstra* (1975), and the Se-Vit. E deficiency symptoms.

Cutaneous microangiopathy lesions as described by *Bengtsson et al.* (1978 a) were not observed in the present study. However, the deficient diets used by *Bengtsson et al.* (1978 a, b) were somewhat lower in Se and Vit. E than those used in our experiments. Otherwise the general picture of deficiency was the same in the 2 studies.

CONCLUSION

The use of Se enriched fertilizer proved to be an effective way of increasing the Se concentration of the grain crop, as the content in the barley produced was 5 times higher from treated areas than from untreated ones. There was a tendency to an increase in milk yield of sows following addition of Se plus Vit. E.

The concentration of Se and Vit. E was much higher in colostrum than in milk, and addition of dietary Se and Vit. E increased the concentration of these compounds in both colostrum and milk.

---

* PSE = pale, soft, exudating meat.

There was a slight effect of high dietary Se concentration on growth rate and feed utilization. Low dietary levels of Se and Vit. E was associated with a higher mortality in piglets, and iron toxicity was observed in piglets on low dietary Vit. E.

No signs of the PSE-condition were observed in the Se and Vit. E deficient pigs.

REFERENCES

Andrews, E. D., W. J. Hartley & C. A. Grant: Selenium-responsive diseases of animals in New Zealand. N. Z. vet. J. 1968, *16*, 3—17.

Bengtsson, G., J. Hakkarainen, L. Jønsson, N. Lannek & P. Lindberg: Requirement for selenium (as selenite) and Vitamin E (as α-tocopherol) in weaned pigs. I. The effect of varying α-tocopherol levels in selenium deficient diet on the development of VESD-syndrome. J. Anim. Sci. 1978 a, *46*, 143—152.

Bengtsson, G., J. Hakkarainen, L. Jønsson, N. Lannek & P. Lindberg: Requirement for selenium (as selenite) and Vitamin E (as α-tocopherol) in weaned pigs. II. The effect of varying selenium levels in vitamin E deficient diet on the development of VESD-syndrome. J. Anim. Sci. 1978 b, *46*, 153—160.

Biering-Sørensen, U.: P.S.E. (Pale Soft Exudative) eller såkaldt „muskeldegeneration" hos svin. I. En oversigt over anatomiske, fysiologiske og biokemiske hovedlinier i P.S.E.-genesen med henblik på kødkontrollen. (P.S.E. (Pale Soft Exudative) or so-called muscle degeneration in pigs. I. A survey of anatomical, physiological and biochemical outlines in the P.S.E.-syndrome with reference to meat inspection). Dansk Vet.-T. 1976 a, *59*, 809—822.

Biering-Sørensen, U.: P.S.E. (Pale Soft Exudative) eller såkaldt „muskeldegeneration" hos svin. II. En oversigt over særlige forhold vedrørende P.S.E.-udviklingen med henblik på kødkontrollen. (P.S.E. (Pale Soft Exudative) or so-called muscle degeneration in pigs. II. A survey of special conditions concerning the P.S.E.-development with reference to meat inspection). Dansk Vet.-T. 1976 b, *59*, 874—885.

Ewan, R. C.: Effect of Vitamin E and selenium on tissue composition of young pigs. J. Anim. Sci. 1971, *32*, 883—887.

Ewan, R. C., M. E. Wastell, E. J. Bicknell & V. C. Speer: Performance and deficiency symptoms of young pigs fed diets low in Vitamin E and selenium. J. Anim. Sci. 1969, *29*, 912—915.

Froseth, J. A.: Selenium and Vitamin E: Blood and tissue levels in pigs. Acta agric. scand. 1979, Suppl. 21, 219—231.

Gardiner, M. R., J. Armstrong, H. Tels & R. N. Glencross: A preliminary report on selenium and animal health in Western Australia. Aust. J. exp. agric. Anim. Husb. 1961, *2*, 261—269.

Gissel-Nielsen, G.: Selenmangel hos danske husdyr. (Selenium deficiency in Danish livestock. Ugeskr. Agron. Hort. 1972, *1*, 9—14.

Gissel-Nielsen, G.: Control of selenium in plants. Risø Report no. 370, 1977.

Grant, C. A.: Morphological and aetiological studies of dietetic microangiopathy in pigs ("mulberry heart"). Acta vet. scand. 1961, 2, Suppl. 3, 107 pp.

Groce, A. W., E. R. Miller, K. K. Keahey, D. E. Ullrey & D. J. Ellis: Selenium supplementation of practical diets for growing-finishing swine. J. Anim. Sci. 1971, *31*, 905—911.

Hartley, W. J. & A. B. Grant: A review of selenium responsive diseases of New Zealand livestock. Fed. Proc. 1961, *20*, 679—688.

Hasitschka, R. & P. Hasitschka: Beobachtungen zum Auftreten der Diätetischen Mikroangiopathie ("Mulberry Heart") des Schweines im nordöstlichen Niederösterreich. (Observations on the appearance of dietetic microangiopathy (Mulberry heart) in pigs in the Northeastern part of Austria). Wien. tierärzlt. Mschr. 1973, *60*, 215—217.

Hjarde, W., E. Leerbeck & T. Leth: The chemistry of Vitamin E (including its chemical determination). Acta agric. scand. 1973, Suppl. 19, 87—97.

Hoekstra, W. G.: Biochemical function on selenium and its relation to Vitamin E. Fed. Proc. 1975, *34*, 2083—2089.

Jørgensen, P. F., J. Hyldgaard-Jensen & J. Moustgaard: Glutathione peroxidase activity in porcine blood. Acta vet. scand. 1977, *18*, 323—334.

Kubota, J., W. H. Allaway, D. L. Carter, E. F. Cary & V. A. Lazar: Selenium in crops in the United States in relation to selenium-responsive diseases of animals. J. agric. Food Chem. 1967, *15*, 448—453.

Lannek, N., P. Lindberg, G. Nilsson, G. Nordström, K. Orstadius & B. Åberg: Production of muscular dystrophy in pigs by feeding certain grains. Zbl. Vet.-Med. 1960, *7*, 403—410.

Ludvigsen, J. B.: Problemer i svineproduktionen. (Problems in pig production). Medlemsbl. danske Dyrlægeforen. 1964, *47*, 87—98.

Mahan, D. G., J. E. Jones, J. H. Cline, R. F. Cross, H. S. Teague & A. P. Grifo, Jr.: Efficacy of selenium and Vitamin E injections in the prevention of white muscle disease in young swine. J. Anim. Sci. 1973, *36*, 1104—1108.

Michel, R. L., C. K. Whitehair & K. K. Keahey: Dietary hepatic necrosis associated with selenium-Vitamin E deficiency in swine. J. Amer. vet. med. Ass. 1969, *155*, 50—59.

Nielsen, H. E., N. J. Højgaard-Olsen, W. Hjarde & E. Leerbeck: Vitamin E content in colostrum and sows milk and sow milk yield at two levels of dietary fats. Acta agric. scand. 1973, Suppl. 19, 35—38.

Olson, O. E.: Fluorometric analysis of selenium in plants. J. Ass. off. anal. Chem. 1969, *52*, 627—634.

Onderscheka, K.: Untersuchungen über Menge und Zusammensetzung der Schweinemilch und den Einfluss dieser Faktoren auf das Wachstum der Ferkel. (Investigation of quantity and composition of sow milk and the influence of those factors on the weight gain of piglets). Beiheft, Wien. tierärztl. Mschr. 1969, *56*, 40 pp.

Pedersen, O. K.: Testing of breeding animals for meat production and meat quality in Denmark. N.J.F. symp. Muscle Function and Porcine Meat Quality. Hindsgavl Castle 1977, 20 pp.

Piper, R. C., J. A. Froseth, L. R. McDowell, G. H. Kroening & I. A. Dyer: Selenium-Vitamin E deficiency in swine fed peas (Pisum sativum). Amer. J. vet. Res. 1975, *36*, 273—281.

Rasmussen, O. K.: Selenium concentration and deposition. Performance and carcass quality in pigs fed different levels of sodium selenate. Acta agric. scand. 1974 a, *24*, 115—125.

Rasmussen, O. K.: Selenium concentration in sow colostrum and sow milk. Acta agric. scand. 1974 b, *24*, 175—178.

Thomke, S., O. Dahl & K. A. Persson: Tocopherol and selenium in pig rations, including an assessment of meat quality parameters. Acta agric. scand. 1965, *15*, 262—274.

Tollerz, F.: Vitamin E, selenium (and some related compounds) and tolerance towards iron in piglets. Acta agric. scand. Suppl. 1973, 19, 184—187.

Trapp, A. L., K. K. Keahey, D. L. Whitenack & C. K. Whitehair: Vitamin E-selenium deficiency in swine: differential diagnoses and nature of field problem. J. Amer. vet. med. Ass. 1970, *157*, 289—300.

Ullrey, D. E.: Dietary selenium requirements of growing-finishing swine. Res. Rep. Mich. St. Univ. agric. exp. Stn 1971, *148*, 36—42.

Van Vleet, F. F., G. Ruth & V. J. Ferrans: Ultrastructural alterations in skeletal muscle of pigs with selenium-Vitamin E deficiency. Amer. J. vet. Res. 1976, *37*, 911—922.

Wastell, M. E., R. G. Ewan, M. W. Vorhies & V. C. Speer: Vitamin E for growing and finishing pigs. J. Anim. Sci. 1972, *34*, 969—973.

Young, L. G., R. M. Miller, D. E. Edmeades, A. Lem, G. C. Smith & G. J. King: Selenium and Vitamin E supplementation of high moisture corn diets for swine reproduction. J. Anim. Sci. 1977, *45*, 1051—1060.

SAMMENDRAG

Selen- og vitamin E mangel hos svin. I. Indflydelse på vækst og reproduktion.

Virkningen af peroralt tilført selen (Se) og vitamin E (Vit. E) på vækst og reproduktion hos svin er blevet undersøgt. To niveauer af Se blev anvendt, nemlig 0,03 og 0,06 mg Se pr. kg foder, og inden for hvert Se niveau blev givet 2 mængder af Vit. E, 15 og 45 i.e. pr. kg foder.

Hverken Se eller Vit. E havde signifikant indflydelse på søernes mælkeydelse, kuldstørrelsen, grisenes fødselsvægt eller hæmoglobinværdierne ved fødsel, ved 3 og 8 ugers alderen. Dog var der en tendens til en højere mælkeydelse hos søer, der fik den største mængde af Se og Vit. E i foderet, og kuldene var lidt større fra de søer, der fik foder med den højeste koncentration af Vit. E.

Koncentrationen af Se og Vit. E var langt højere i kolostrum end i mælk. Tilskud af Se og Vit. E i foderet havde en udtalt forøgende effekt på koncentrationen af disse næringsstoffer både i kolostrum og mælk.

Lav Se og Vit. E i søernes foder og i mælken bevirkede, at pattegrisedødeligheden steg. Hos pattegrise fra søer på det lave niveau af Vit. E blev der konstateret nogle tilfælde af forgiftninger i forbindelse med parenteral indgift af jern som forebyggende middel mod anæmi. PSE (Pale Soft Exudative) fænomenet blev ikke observeret i forsøget og kan sandsynligvis ikke blive associeret ved mangel på Se eller Vit. E i foderet.

(Received July 31, 1978).

Reprints may be requested from: M. G. Simesen, the Institute of Internal Medicine, Royal Veterinary and Agricultural University, Bülowsvej 13, DK-1870 Copenhagen V, Denmark.