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PATHOLOGICAL LESIONS IN SWINE AT SLAUGHTER

VI. THE RELATION BETWEEN SOME MAINLY NON-ENVIRONMENTAL FACTORS, DISEASES, WEIGHT GAIN AND CARCASS QUALITY*

By

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FLESJÅ, KJELL I., INGE B. FORUS and INGVAR SOLBERG: *Pathological lesions in swine at slaughter. VI. The relation between some mainly non-environmental factors, diseases, weight gain and carcass quality.* Acta vet. scand. 1984, *25*. 309—321. — The influence of some diseases (lesions at slaughter) on daily weight gain and the relation between some mainly non-environmental factors and diseases, weight gain and carcass quality were studied in 12 herds running an all in/all out fattener production. The material consisted of 9800 baconers slaughtered in the period 1975—1977. The piglets were purchased when about 10 weeks old. The number of batches was 60.

The investigation showed that 6 of the 12 diseases included in the analyses had a statistically significant influence on daily weight gain: pyaemia, atrophic rhinitis, severe and moderate pneumonia, tail lesion and scabies. The effect varied from a calculated reduction of 60 g in daily weight gain in pigs having atrophic rhinitis to a positive influence of 5 g/day in animals with recorded scabies lesions.

It was also found that an increase in weight of marketing piglets would reduce the risk of contracting many diseases and accordingly increase the frequency of healthy animals. It also seemed possible to increase the frequencies of healthy animals by buying quality piglets. Further, quality piglets had a positive relation to weight gain and best paid carcasses (highest quality). Analyses of flock based antiparasitic treatment were inconclusive with regard to weight gain, parasitic hepatitis and scabies.

disease recording; slaughter-house; bacon pigs; antiparasitics.

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Subclinical diseases and parasites affecting bacon pigs cause considerable economic losses in pig farming by leading to growth retardation and reduced carcass quality at slaughter (*Huhn* 1970, *Bäckström et al.* 1976, *Penny* 1977, *Plonait* 1978, *von Crammon* 1978, *Truijen & Tielen* 1980, *Pichler* 1980, *Larsen & Storm* 1980). In a previously published paper relations between some environmental factors and recorded lesions at slaughter were discussed (*Flesjå et al.* 1982). The purpose of this paper is to present estimates of the influence of some mainly non-environmental factors on recorded lesions, growth rate and carcass quality.

MATERIAL AND METHODS

The material consisted of approx. 9800 fatteners slaughtered in the period 1975—1977. The animals came from 12 herds running an all in/all out production. The total number of batches was 60, varying from 1 to 7, with an average of 5 for each herd. Piglets were purchased when about 10 weeks old from randomly selected herds and put together in fattening units. Three qualities of piglets were marketed: superior, first class and ordinary. Classification of superior and first class piglets was based on herd standard, participation in the herd control program (superior), hereditary index of the ancestors and normal growth of the litter. About 15 % of the piglets were ordinary, i.e. with-

Table 1. Average values (weighted) of the parameters used in the analyses.

Parameter	Average value	s	Parameter	Average value (%)	s
Piglet weight	26.1 kg	± 0.2	Pyaemia	0.6	± 0.4
Piglet quality: Superior	18.4 %	± 0.4	Abscesses	2.1	± 0.8
			Atrophic rhinitis	0.3	± 0.5
Piglet quality: First class	67.3 %	± 0.5	Severe pneumonia	1.2	± 0.9
Rearing period	131 days	± 2	Moderate „	6.0	± 2.2
Daily weight gain	0.632 kg	± 0.026	Pleurisy	7.8	± 2.2
Carcass weight	75.4 „	± 0.4	Pericarditis	3.6	± 1.1
Carcass quality: *	55.3 %	± 6.0	Severe parasitic hepatitis (Numerous white liver spots)	11.3	± 3.9
Carcass quality: 1+	25.7 „	± 3.9	Moderate parasitic hepatitis (Few white liver spots)	2.5	± 1.4
Healthy animals	56.1 „	± 4.4	Perihepatitis	1.9	± 0.8
			Scabies	12.3	± 3.4
			Tail lesion (cannibalism)	3.0	± 1.2

out any special herd or parental requirements. Table 1 shows the average values of other parameters discussed in this paper.

Herd records made it possible to calculate the relative frequencies of each category of piglets and average weight on arrival. Slaughter-house data contained information concerning day of killing, weight, quality of the carcass, and detected lesions (*Flesjå & Ulvesæter* 1979). Daily weight gain "G" was estimated according to the following formula: $\text{"G"} = \frac{\text{LWS} - \text{LWP}}{\text{N}}$

LWS is estimated live weight at slaughter (carcass weight being 71 % of live weight), LWP average piglet weight, and N days of fattening.

Antiparasitic treatment was performed on a flock basis. Most farmers carried out this treatment in an irregular and inconsistent manner, but 2 farmers did not treat their animals at all and 3 systematically treated each batch twice. The anthelmintics used were piperazin-carbodithion acid and pyrantel tartrate, and, as antacarides, metrifonatum, dipylate and lindane.

Applied analytical methods have been a combination of regression analyses of variance and stepwise regression (both forward and backward elimination) (*Searle* 1971, *Helwig & Council* 1979). Squared multiple correlation coefficients (r^2) were also obtained.*

RESULTS

Table 2 shows the estimated effect of different diseases (lesions) on daily weight gain. It appeared that disorders of the respiratory system — and particularly atrophic rhinitis — had a clear negative influence. The average rearing period was about 131 days. The estimate indicates that atrophic rhinitis would cause a growth retardation of 7—8 kg in this period or prolong rearing for 10—14 days.

In the model used to check the relations presented in Table 2 the relation between classification of the carcass (*Flesjå & Ulvesæter* 1980) and daily weight gain was also calculated. It turned out that pigs achieving the highest scores as carcasses had a

* The analyses have beeen performed by the Agricultural Research Council's Centre for Experimental Design and Data Processing, Ås, Norway.

Table 2. Estimates of the influence of some diseases (lesions at slaughter) on daily weight gain. Only relations showing statistical significance ($P \leq 0.05$) are presented.

Disease	Influence on daily weight gain (g)
Pyaemia	— 50
Atrophic rhinitis	— 58
Severe pneumonia	— 28
Moderate pneumonia	— 10
Tail lesion (cannibalism)	— 18
Scabies	+ 5
Diseased animal	— 5
Squared multiple correlation coefficient (r^2)[a]	0.67

[a] Herd identity and carcass quality were also statistically significant variables included in the analytical model contributing considerably to the relatively high r^2.

reduced growth of 50 g per day compared to those getting a lower classification (non-classified excluded).

Table 3 shows the relations that could be detected in this material between average piglet weight, piglet quality, days of rearing and different lesions and healthy animals.

The results indicate that an increase in piglet weight will reduce the frequencies of many lesions and accordingly increase the number of healthy animals. It is also demonstrated that an increase in days of rearing is related to an increase in many lesions, and that high quality piglets give an increase in frequencies of healthy animals, but at the same time lead to a higher risk of contracting severe pneumonia and parasitic hepatitis. However, it should be noted that our analytical model only "explains" 17—46 % (r^2) of the variation in frequencies of the actual lesions.

Estimates of how piglet weight, piglet quality, and healthy animals are related to daily weight gain and carcass classification are presented in Table 4.

The variables included had a relatively limited influence on the variations present, but there was a statistically significant relation between high piglet quality and highest carcass quality. Piglet quality also had a positive influence on daily weight gain, whereas healthy animals had no significant relation to the factors in question.

Table 3. Estimates of the influence of piglet weight, piglet quality, and rearing period on recorded lesions and healthy animals. The estimates show the changes in frequencies of each lesion if piglet weight, piglet quality and rearing period increase by one unit (kg, %, day).

	Frequency changes (%)									
	Artrophic rhinitis	Pneumonia sev.	Pneumonia mod.	Pleurisy	Parasitic hepatitis sev.	Parasitic hepatitis mod.	Perihepatitis	Scabies	Tail-lesion	Healthy animals
Piglet weight	—0.2[a]	—0.8[b]	—1.3[a]	—1.8[b]	—0.8	—0.6	0.2	—1.7	—0.7[a]	3.3[a]
Piglet quality / Superior	—0.01	0.11[b]	0.11	0.7	0.36[a]	0.13[a]	0.04	0.27	0.07	0.63[b]
Piglet quality \ First class	0.01	0.07	0.09	0.02	0.21	0.09	0.02	0.31[a]	0.06	0.45[a]
Rearing period	0.01[a]	0.00	0.00	0.07[b]	0.00	0.00	0.02[a]	0.10[a]	0.03	—0.10[a]
Squared multiple correlation coefficient (r^2)	0.29	0.23	0.30	0.46	0.32	0.39	0.17	0.32	0.23	0.35

a) The relation between the lesion and variables has a statistical significance of $0.01 < P < 0.05$.
b) $0.001 < P < 0.01$.
c) Herd identity is a statistically significant variable included in the model thus influencing r^2.

Table 4. Estimates of the influence of piglet weight and piglet quality on daily weight gain and carcass qualitiy. It is also shown how healthy animals are related to the same factors. The estimates show how much daily weight gain (g) and carcass quality (%) change when piglet weight, piglet quality increase by one unit (kg, %).

	Influence on daily weight gain (g)	Influence on carcass classification (%)	
		* quality	1+ quality
Piglet weight	2.9	—2.4[a]	1.1
Piglet quality: Superior	1.7[a]	0.35[a]	—0.03
Piglet quality: First class	1.8[a]	0.40[b]	—0.09
Healthy animals	0.6	—0.02	—0.02
Squared multiple correlation coefficient (r^2)	0.21	0.11	0.13

a) The relation has a statistical significance of $0.01 < P < 0.05$.
b) $0.001 < P < 0.01$.

Table 5. Estimates of the influence of anthelmintic treatment on daily weight gain* and frequencies of parasitic hepatitis.

No. of treatments	No. of batches	Influence on daily weight gain (g)	Frequencies of parasitic hepatitis (%)	
			severe	moderate
0	20	0	13.5	2.8
1	7	—13	13.7	3.1
2	29	—18	9.3	2.8
3	1	—34		

Table 6. Estimates of the influence of ectoparasitic treatment on daily weight gain* and frequencies of sarcoptic lesions. The difference between 0 and 2 treatments on daily weight gain is of statistical significance ($P < 0.05$).

No. of treatments	No. of batches	Influence on daily weight gain (g)	Frequencies of sarcoptic lesions (%)
0	25	0	15.4
1	6	1	11.6
2	21	24	14.1
3	4	2	7.1
4	1	45	

* The analyses concerning daily weight gain also had lesions, carcass quality, herd identity and production period as variables.

Tables 5 and 6 show the estimated effect of antiparasitics on daily weight gain and parasitic lesions in skin and liver.

The results suggest a certain positive influence of acaricides on daily weight gain, but a negative influence of anthelmintics. It is noteworthy that none of the antiparasitics had a statistically significant effect on the frequencies of lesions usually related to these parasites.

DISCUSSION

It is a common observation that there is a certain difference in the daily weight gain in pigs achieved by different farmers. Such a variation may reflect management — including intensity and quality of feeding — and genetic quality of the animals. However, it may also be influenced by disease problems, which again are influenced by rearing systems and environmental factors (*Flesjå & Solberg* 1981, *Flesjå et al.* 1982). The influence of food quality was not evaluated in this investigation. All farmers fed their pigs with commercially produced mixtures of concentrate.

In the present work an attempt is made to estimate the relation between diseases — lesions at slaughter — and daily weight gain. It should be noted that this is a field investigation, which implies that some of the basic data are approximations. It was for example impossible to get the exact weight of each piglet. Therefore batch averages are used in the calculations. However, this has been accepted, since deviations are considered casual. The quality and price systems also favour marketing within a limited range of weight. Likewise the variable piglet quality is based on distribution within each batch. Furthermore it should be kept in mind that a high number of variables are included in the analyses. It may increase the risk of attaining statistical significance by chance and co-linearity.

Six of the 12 diseases (lesions) included in this study influenced daily weight gain at a statistically significant level. The majority of these lesions were considered to be of a chronic nature, and this may explain their negative influence. The calculated effect of respiratory diseases is in accordance with most studies published (*Done* 1972, *Bäckstrøm et al.* 1975, *Ross* 1981, *Switzer* 1981). Growth retardation seems to reflect the severity of the lesion. *Bäckstrøm et al.* (1976) report that reduction in daily weight gain varied from 7 to 44 g according to the severity

of atrophic rhinitis. *Huhn* (1970), *Tielen* (1974), *Lindqvist* (1974), *Martinsson* (1979) and *Mandrup* (1982) made similar observations with regard to severe and moderate pneumonia. *Willeberg et al.* (1978) found that growth retardation was more related to the severity of preceding clinical disease than to the presence of chronic lesions at slaughter. However, *Björklund & Henricson* (1966) and *Pearce & Roe* (1967) recorded no influence of respiratory disease on growth.

Tail lesion (cannibalism) was recorded in about 3 % of the carcasses. Its economic implication, however, is great, since it often implies pyaemia and total condemnation. The detected relation between cannibalism and daily weight gain is in accordance with the observations made by *Hagen & Skulberg* (1960) and *England & Spurr* (1967). On the other hand, as most tail biting takes place when the pigs are 50—75 kg (*Bielenberg* 1971, *Steiger & Arnold* 1975), and as herd-owners in fear of pyaemia often slaughter the injured animals as quickly as possible, they may be slaughtered before they achieve the period of maximum weight gain.

Scabies seems, oddly enough, to be related to an increase in growth rate. This result contrasts with most data previously published (*Cargill & Dobson* 1979b, *Larsen & Storm* 1980). However, our recorded scabies lesions are probably hypersensitivity reactions (*Flesjå & Ulvesæter* 1980). It has been found that infestations of scabies only last for a limited period of time in otherwise healthy animals (*Sheaham* 1974, *Cargill & Dobson* 1979a). Thus the recorded reaction may indicate a recent reinfestation, and furthermore it could mean that the observed positive relation between recorded scabies and weight gain may represent the typical reaction in an especially thriving animal. Previously published results may sustain such a notion (*Flesjå & Ulvsæter* 1980).

The 3 piglet parameters and the production period were related to lesions at slaughter to a varying degree (Table 3). Piglet weight seemed to have the strongest influence. An increase of piglet sales weight by e.g. 2 kg, might reduce the frequencies of respiratory diseases and cannibalism by about 6 % and increase frequencies of healthy animals correspondingly. *Martinsson* (1979) made similar observations concerning respiratory lesions. It seems as if the heavy piglets are most resistant to the pathogens and stress encountered in the tough environ-

ment of fattening houses. But it could also mean that the light piglets are small because they have contracted disease at an early age, and that the environment in fattening houses offers limited opportunities for recovery.

Both piglet weight and quality had a positive influence on daily weight gain (Table 4). And like *Martinsson* (1979), we found a positive relation between quality piglets and the highest classified carcasses. However, our analytical model "explains" only 11 % (r^2) of the variation in this group, implying that some more influential factors are probably present. One such factor could be feeding. The highest classified fatteners had a considerably lower daily weight gain than the lower classified. This could be a reflection of reduced food intake (restricted feeding) in the first category.

The analyses of the effect of antiparasitics gave some rather remarkable results. Neither ascaricides nor acaricides had any statistically significant effect on the frequencies of the lesions associated with these parasites. One reason could be that most producers of fatteners run campaigns against parasites in the first and second month of fattening without concomitant and substantial cleaning of the pens, with a resulting high risk of reinfection. In addition, this kind of practice may lead to such a low level of infestation that development of immunity is delayed (*Andersen et al.* 1973, *Jørgensen et al.* 1975, *Cargill & Dobson* 1979a). The antiparasitics used showed no convincing effect on weight gain. But results presented might lead to the notion that ascaricides had a depressive effect. *Olsson* (1977) did some field experiments using piperazin-carbodithion acid and metrifonatum as anthelmintics. His observations may indicate that the former had a negative influence on daily weight gain. In our material 75 % of the treated batches had been given piperazin-carbodithion acid and the rest pyrantel tartrate. However, the negative effect might not be a peculiarity of the carbodithion compound. *Nilsson & Martinsson* (1980) noticed a lower weight gain in pigs treated with levamisole than in non-treated controls.

In conclusion it can be said that some lesions — especially those reflecting chronic diseases — had a negative influence on daily weight gain, that an increase in piglet weight and high quality piglets resulted in more healthy animals at slaughter, and that the applied antiparasitic regimes had no convincing

positive influence on daily weight gain or the frequency of parasitic lesions.

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SAMMENDRAG

Patologiske funn på gris ved slakting. VI. Sammenheng mellom patologiske funn og daglig tilvekst og mellom noen overveiende ikke miljømessige faktorer og sjukdom, tilvekst og slaktekvalitet.

De nevnte forhold ble studert i 12 besetninger med alt inn/alt ut produksjon av slaktegris. Materialet bestod av 9800 gris slaktet i perioden 1975—1977. Grisene ble innkjøpt ca. 10 uker gamle. Det totale antall innsett var 60. Sjukdomsfunn gjort ved kjøttkontrollen sammen med andre data fra slakteriet og registreringer utført i besetningene dannet grunnlaget for de statistiske beregninger.

Undersøkelsen viste at 6 av de 12 sykdommer som inngikk i analysene, hadde en statistisk sikker innflytelse på daglig tilvekst, nemlig: Pyaemi,, atrofisk rhinitt, utbredt og moderat lungebetennelse, halesår og skabb. Utslaget svingte mellom en redusert tilvekst på 60 g/dag for atrofisk rhinitt til en øket tilvekst på 5 g ved påviste skabblesjoner.

Det ble funnet at en økning i smågrisvekt ville redusere frekvensen av flere sjukdommer og følgelig resultere i høyere frekvens friske dyr. Det synes videre å være en positiv sammenheng mellom kvalitetssmågris og friske dyr, daglig tilvekst og høy slaktekvalitet.

Antiparasitær behandling mot spolorm og skabb så ikke ut til å ha noen klar positiv effekt verken på tilvekst eller parasittlesjoner i lever og hud.

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