

From the Regional Veterinary Laboratory, Sandnes, Norway.

PATHOLOGICAL LESIONS IN SWINE AT SLAUGHTER

IV. PATHOLOGICAL LESIONS IN RELATION TO REARING SYSTEM AND HERD SIZE*

By

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FLESJÅ, KJELL I. and INGVAR SOLBERG: *Pathological lesions in swine at slaughter. IV. Pathological lesions in relation to rearing system and herd size.* Acta vet. scand. 1981, 22, 272—282. — Data from the meat inspection at a large regional abattoir in Norway was used to study the effect of different production systems and herd size on the occurrence of pathological lesions in pig carcasses. Three production systems were compared: combined production, production strictly in batches and continuous production. Only the former reared its own piglets. The data was collected in the period 1975—1977. The number of herds varied between 87 and 94, and between 26,000 and 30,000 bacon pigs were slaughtered each year. The herds were divided into three different size groups: ≤ 200 , 201—400, and > 400 pigs slaughtered annually. Each year was considered separately.

The study showed that the highest frequency of sound carcasses occurred in the combined production group. There was no significant difference between the two production groups rearing purchased piglets. Moreover, there was an inverse relationship between the frequency of sound carcasses and herd size, but the positive effect of the small herd was estimated to be less important than that of production system.

The distribution of 16 different pathological lesions was also considered. Four lesions (pneumonia — moderate and severe —, pleurisy and scabies) were recorded at significantly different levels in the production systems all three years of recording.

Analysis of the effect of herd size also showed that in the cases of moderate pneumonia and pleurisy, the small herds were at an advantage. The other lesions had a rather casual distribution among the groups.

The statistical evaluation indicates however, that in cases of significant differences between the tested groups, only 20—40 % of the variation could be “explained” by our model comprizing production systems and herd size groups.

disease recording; slaughter-house; bacon pigs; lesions; production systems; herd size; inter-relations.

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In recent years there has been a considerable interest in management and environment as factors influencing many non-lethal but presumably costly diseases in pigs (Bäckstrøm & Larsson 1971, Lindquist 1974, Aalund *et al.* 1976, Penny 1977, Bäckstrøm & Bremer 1976, 1978, Plonait 1978, Martinsson 1979).

This paper is based on selected data from a large regional abattoir in the south-western part of Norway (Sentralslakteriet, Forus, Stavanger) over a period of three years. The various lesions recorded at the meat inspection have been studied in relation to management and herd size.

MATERIAL AND METHODS

The previously described disease recording system (Flesjå & Ulvesæter 1979) has formed the base for the present investigation. In the period 1975 to 1977, about 85,000 pigs from 1100—1200 herds were slaughtered annually. From this pool about 90 herds producing approx. 28,000 baconers a year, ranging from 30 to 1600 per herd, were selected for this study. Only herds with a stable production system during the recording period were included.

Three production systems were considered: combined production (integrated production), production in batches (all in/all out), and continuous production.

Table 1 shows that there were few large combined herds and that in the continuous production group there is a concentration of medium sized herds. Further, it will be noted that a certain reduction of small herds took place during the recording period. The percentage of sound carcasses and different lesions was calculated for each herd.* The figures were analysed in an unweighted two-way analysis of variance, with production system and herd size as factors. The means for main effects were tentatively ranked by a Duncan multiple test (Duncan 1975) $P < 0.05$. It should be stressed that this test compares mean values and not the pure effect of production system or of herd size. Multiple correlations (r^2) were also obtained. Each year was analysed separately.

* The data have been arranged by the Agricultural Research Council's Centre for Experimental Design and Data Processing, Ås, Norway.

Table 1. Relations between herd size and and production systems, number of herds and number of slaughtered baconers yearly.

Year	Production system	< 200 slaughtered		201—400 slaughtered		> 400 slaughtered		Total	
		Herds	Animals	Herds	Animals	Herds	Animals	Herds	Animals
1975	Combined (own piglets)	22	2497	9	2922	3	1479	34	6898
	In batches (purchased piglets)	10	1464	15	4388	10	5761	35	11613
	Continuous (purchased piglets)	3	181	8	2084	7	5132	18	7397
	Total	35	4142	32	9394	20	12372	87	25908
1976	Combined (own piglets)	15	2467	15	4167	4	1822	34	8456
	In batches (purchased piglets)	6	744	18	4962	12	6084	36	11790
	Continuous (purchased piglets)	4	523	9	2500	5	4224	18	7247
	Total	25	3734	42	11629	21	12130	88	27493
1977	Combined (own piglets)	16	2567	15	4192	5	2377	36	9136
	In batches (purchased piglets)	8	1265	16	4448	14	8148	38	13861
	Continuous (purchased piglets)	4	558	14	3810	2	2690	20	7058
	Total	28	4390	45	12450	21	13215	94	30055

RESULTS

Table 2 presents the frequencies of sound carcasses under the three different rearing systems. It also shows the relative figures after rearranging the material in herd size groups.

It will be noted that the highest frequencies of sound carcasses were recorded in the combined production group and the lowest in the continuous production group. Production in batches showed intermediate figures. However, the Duncan's ranging test indicates that the partition between the production systems really lies between own and purchased piglets.

The table also shows an inverse relationship between sound pigs and herd size, but statistical analysis accepted only the small herd group as a separate entity in all three years of re-

Table 2. Frequencies (%) of sound baconers at slaughter related to production system and herd size. (Statistical analysis has been performed for each year and each category. Different letters (A, B and C) indicate significantly different frequencies ($P < 0.05$) between the compared groups, double letters (AB) that the group is neither different from A nor B).

Year	Production system			Herd size (slaughtered yearly)		
	Combined	In batches	Continuous	≤ 200	201—400	> 400
1975	66.4 A	58.8 B	53.8 B	66.5 A	59.1 B	53.3 C
1976	67.6 A	57.8 B	53.7 B	63.7 A	60.8 AB	57.2 B
1977	66.1 A	57.0 B	52.8 B	64.3 A	59.0 B	55.8 B

coding. However, the results might be influenced by a relatively high number of combined herds in this group.

Sixteen types of lesions occurred at a frequency of 0.3 % or more in the total material (*Flesjå & Ulvesæter* 1979). These lesions have been studied in the present material, arranged according to production system and herd size.

Table 3 shows the four lesions which occurred at significantly different levels in the production systems all three years of recording. Although the remaining 12 lesions showed figures

Table 3. Frequencies (%) of some pathological lesions in baconers at slaughter related to production system and herd size. (Statistical analysis has been performed for each lesion, each year and each category.)

Code — Lesion	Year	Production system			Herd size (slaughtered yearly)		
		Combined	In batches	Continuous	≤ 200	201—400	> 400
11 — Severe pneumonia	1975	0.28 A*	1.27 B	1.47 B	0.80 A	0.79 A	1.34 A
	1976	0.54 A	1.22 B	1.18 B	0.22 A	1.08 B	1.56 B
	1977	0.55 A	1.12 B	1.53 B	0.67 A	0.76 A	1.89 B
12 — Moderate pneumonia	1975	2.61 A	6.27 B	8.18 B	3.67 A	5.55 B	7.49 C
	1976	2.96 A	5.38 B	7.14 C	3.13 A	5.00 B	6.40 C
	1977	3.49 A	6.35 B	6.22 B	3.96 A	5.27 AB	6.77 B
13 — Pleurisy	1975	5.49 A	6.46 A	10.56 B	4.86 A	5.88 A	12.24 B
	1976	5.80 A	7.37 A	11.75 B	5.11 A	8.41 B	9.20 B
	1977	6.24 A	9.81 B	12.93 B	6.22 A	9.87 B	11.31 B
60 — Scabies	1975	5.50 A	11.78 B	12.94 B	6.81 A	10.79 B	12.43 B
	1976	6.78 A	15.52 B	15.89 B	11.84 A	11.65 A	13.30 A
	1977	6.36 A	13.48 B	15.12 B	10.89 A	10.37 A	12.79 A

* means with the same letters are not significantly different ($P > 0.05$). (cf. Table 2.)

which preclude definite conclusions, a general account of the statistics is given below.

Liver condemnation caused by larvae migrans of ascarids (code 31) was most common in pigs reared in batches and rarest in animals from combined production. However, the difference was statistically significant only for two of the three years of recording. The distribution of partial condemnation, due to "white spots" (code 32), showed about the same pattern as that of code 31.

Abscess/-es (code 07) also occurred regularly with the lowest frequency in the combined production group. The highest figures were recorded in the continuous production group, but the difference was statistically significant for two years only.

Concerning pericarditis (code 14), there was no statistical distinction between the groups. However, animals in the batch production group tended to have fewer lesions than those in the other two groups.

Arthritis (code 51) had also the lowest frequency in the batch production group and there was a statistical difference between this group and the continuous production group in two of the three years.

There was no statistically significant difference between groups in terms of tuberculous lesions in cervical lymph nodes (code 21), although the highest figures were noted in the group rearing own piglets.

The other lesions tested had varying distributions among the three production groups. However, it is worth mentioning that the continuous production group, in all three years of recording, had the highest figures for "other liver lesions" — mainly perihepatitis — (code 39). Also the frequency of tail lesions (code 62) in pigs raised in batches was lower than that in pigs from combined production systems.

Two lesions — moderate pneumonia (code 12) and pleurisy (code 13) occurred at significantly different levels in the herd size categories for all three years of recording (Table 3). The lowest frequencies were recorded in the small herd group, the highest in the large herd group. However, the analysis of variance indicates that the effect of herd size was less pronounced than that of rearing system.

Multiple correlations (r^2) concerning the four types of lesions which occurred at significantly different levels among production systems/herd size groups varied between 0.2 and 0.4.

DISCUSSION

As expected, the combined herd group had the highest prevalence of "healthy" pigs (Table 2). The results are in accordance with those of several Scandinavian investigators (*Cederwall & Holm* 1974, *Aalund et al.* 1976, *Bäckstrøm & Bremer* 1976, 1978, *Martinsson* 1979). Statistical analyses show that the "combined herd effect" was present even in the large herds. In the other production groups, numerical differences indicate a negative "large herd effect". These herds obtain piglets from different sources, thus various pathogens are likely to be present. In the continuous production system there is, in addition, the effect of accumulation of pathogens and the risk of increased virulence through continuous animal passages.

In all three years of recording, the combined herd group had the lowest frequency of abscess/-es and the continuous production group had the highest. This favourable effect of the integrated herd system may be related to a balance between animals and pathogens in a closed environment.

Atrophic rhinitis was recorded rather evenly among the groups. A higher frequency in the large herds in continuous production could be expected, considering the observation of *Bäckstrøm & Bergstrøm* (1977). However, our results correspond better with those of *Switzer & Farrington* (1975) and *Giles et al.* (1980). These authors conclude that, although many pigs in commercial bacon pig herds are exposed to the actual agents, mainly pigs infected as piglets develop nasal abnormalities.

Pneumonias were recorded at significantly lower levels in the combined production group as compared to the two rearing purchased weanlings. There was also a difference between the small and the large herds, but analysis of variance indicates that the influence of production system is greater than that of herd size. Similar observations have been reported by many investigators (*Bäckstrøm & Larsson* 1971, *Cederwall & Holm* 1974, *Aalund et al.* 1976). The results sustain the assumption that a favourable balance develops between the actual pathogens and the animals in the combined herds.

In an earlier paper, we demonstrated a clear-cut relationship between pneumonias and pleurisy (*Flesjå & Ulvesæter* 1980). However, the relationship was not so clearly reflected in the present analysis. It would appear that statistically significant distinction regarding pleurisy occurs between the continuous

production system and the other two, rather than between own/purchased pigs as in pneumonia.

Most cases of recorded pneumonias are of the type associated with *Mycoplasma suis*, possibly complicated by *Pasteurella multocida* or other bacterial infections. These agents might well reach the pleura, causing pleuropneumonias. However, other bacteria, such as *Hemophilus* species, may leave pleurisy as a visiting card, especially under conditions of frequent animal passages (Nielsen *et al.* 1976, Bäckström *et al.* 1976). This could partly explain the high frequency of pleurisy in the continuous production group and also in large herds as compared to small ones.

A strong relationship has been found between pleurisy and pericarditis (Flesjå & Ulvesæter 1980). However, this observation was not confirmed by the present study since pericarditis, in contrast to pleurisy, was casually distributed between the groups. Moreover, unlike in other chest lesions, batch-reared pigs tended to have fewer pericarditis lesions. Although serofilous agents probably are the main cause of pericarditis, other factors may be involved. One such factor could be vitamin-E/selenium deficiency (Martinsson 1979). Thus the lesion could be associated with mulberry heart disease which is not uncommon in the district. Many herd owners supply extra vitamin-E and selenium to their pigs in the most risky period. Such periodic supplementation is more easily administered in herds raising pigs strictly in batches than in farms having pigs of all ages.

Tuberculous lesions in the cervical lymph nodes were not recorded at statistically different levels among the production systems. However, the combined herd group had the highest figures for all three years of recording. This tendency might reflect a widespread use of saw dust bedding in the combined herds. Mycobacteria have repeatedly been isolated from sawdust and a relationship between such isolation and tuberculous lesions has been demonstrated (Kleeberg & Nel 1969, Uhlemann *et al.* 1975, Flesjå *et al.* 1978). However, this mechanism does not adequately explain the high frequency in the large herd group, since few large herds use bedding.

The average frequency of "white liver spots" was lowest in the combined herds and highest in the "all in/all out" group. The low frequency in the former could be the result of more consistent antiparasitic programmes in these herds. Their stable environment may also have a favourable effect upon the general

immunologic response in the animals. The numerical difference between the strictly "in batches" group and the continuous production group was also noted by *Lindquist* (1974). The reason for this pattern is not clear, but it is possible that movement of pigs from pen to pen, as practised in many continuous production herds, leads to a massive parasitic impetus resulting in a quick and pronounced immunity (*Jørgensen et al.* 1975).

Another factor may be that pigs from continuously run herds have a slower growth rate and are generally older when slaughtered compared to those from other rearing systems. Therefore, immunity may have developed and liver lesions healed in the older pigs at the time of meat inspection (*Flesjå & Ulvesæter* 1980).

Polyarthritis was diagnosed at low levels in all groups and with a rather casual distribution. For instance, there was no parallelism to the serositides, thus supporting previously published results (*Flesjå & Ulvesæter* 1979, 1980).

Arthritis was regularly recorded at the lowest frequency in the "all in/all out" group and a statistical difference was noted for two of the three years. In addition, the results also indicate that pigs in the middle herd size group were somewhat more affected than those in the other herd groups, suggesting a different etiology concerning these two types of joint lesions (*Flesjå & Ulvesæter* 1979, 1980).

Mange is recorded at significantly lower levels in the combined herds compared to those rearing purchased piglets. The factors mentioned in association with "white liver spots" probably also apply to mange.

A strong relation has previously been demonstrated between pyaemia and tail lesions (*Flesjå & Ulvesæter* 1980). Neither of them were recorded at significantly different levels in any of the groups. This is somewhat surprising since a lower frequency of tail biting (and pyaemia) might be expected in combined herds considering the stable and familiar environment under this system. Many factors have been discussed as triggers of tail biting (*von Cramon* 1978). *Martinsson* (1979) thinks that gilts in heat are prone to biting. This factor could have relevance in the combined herd since the owner might use sign of heat as one criterion for selection of future breeders. Another factor which may provoke cannibalism is overcrowding. Such a situation may occasionally occur in combined herds, since the owners are usually not likely to sell off any superfluous weaners.

The environment consists of a great number of components or factors. Many of these are not easily defined, since they cannot be measured exactly and/or they are multifaceted. Both production system and herd size are two such factors whose study we considered a useful starting point for a more extensive investigation. It should be stressed that in cases of statistically significant effects of production systems or herd size groups, r^2 varied between 0.2 and 0.4. In other words, only 20—40 % of the variation was "explained" by the two factors, and we are at present trying to expand the study by including other environmental factors such as design of the pens, stocking density, feeding, water supply, manure handling, hygiene, etc.

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SAMMENDRAG

Patologiske funn på svin ved slakting. IV. Sammenheng mellom patologiske funn og driftsform og besetningsstørrelse.

Data fra kjøttkontrollen ved Sentralslakteriet, Forus, Stavanger, har vært brukt for å undersøke hvilken innflytelse produksjonssystem og besetningsstørrelse måtte ha for forekomsten av patologiske funn hos griseslakt. Tre ulike driftsformer ble sammenlignet: Kombinert drift (egne smågriser), alt ut/alt inn og kontinuerlig drift. Besetningene ble også oppdelt i 3 forskjellige størrelsesgrupper: ≤ 200 , 201—400 og > 400 årsgris. Data ble innsamlet i perioden 1975—1977. Antall besetninger varierte mellom 87 og 94. Disse leverte mellom 26.000 og 30.000 slaktegriser pr. år. Hvert år ble behandlet separat.

Undersøkelsen viste at kombinert drift-gruppen hvert år hadde den høyeste frekvens av „friske“ slakt og kontinuerlig drift den lågeste. Den statistiske undersøkelsen viste at det ikke var noen signifikant forskjell mellom de to gruppene som kjøpte inn smågris, men mellom disse to og kombinert drift ($P < 0.05$). Man fant også en fallende frekvens av „friske“ slakt ved økende besetningsstørrelse, men den positive effekten av den lille besetning ble i analysen vurdert til å ha mindre betydning enn driftsformen.

En undersøkelse over fordelingen av de 16 vanligst forekommende patologiske funn viste at kun 4 forekom med signifikant forskjellig nivå i en driftsform alle 3 år. Lungebetennelsene, sterk og moderat, og skabb forekom med et signifikant lågere nivå ($P < 0.05$) ved kombinert drift sammenholdt med de andre to, mens pleuritt hadde et signifikant høyere nivå i kontinuerlig drift gruppen sammenlignet med kombinert og „alt inn/alt ut“ gruppene.

Med hensyn til pyemi, abscess/-er, hvite leverflekker-multiple og få-, „andre leverforandringer“ og arthritt varierte resultatene fra år til år, men ved forskjell mellom gruppene kom kombinert drift nesten alltid best ut.

For de øvrige patologiske funn (atrofisk rhinitt, pericarditt, tuberkulose lignende forandringer i halslymfeknutene, peritonitt, polyarthritt og halesår) var det ingen signifikant forskjell mellom driftsformgruppene.

Den statistiske analysen indikerte at moderat lungebetennelse og pleuritt var patologiske funn hvor besetningsstørrelsen også hadde innflytelse på frekvensen.

Videre viste analysen at i de tilfeller hvor det forekom signifikant forskjell mellom produksjonssystemer eller størrelsesgrupper, ble kun 20—40 % av forskjellen forklart utfra den anvendte modell.

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