The locomotion behaviour of slaughter pig groups passing a Hoenderken single-file race of different length or width

MARTINA KLEIBS, R.-B. LAUBE
University Leipzig, Dept. of Animal Genetics, Faculty of Agricultural Science,
Richtestr. 28, O-7030 Leipzig, Germany

LORE SCHÖBERLEIN
Schlacht- und Verarbeitungs-GmbH Leipzig, Dept. of Research and Development, O-7030 Leipzig, Germany

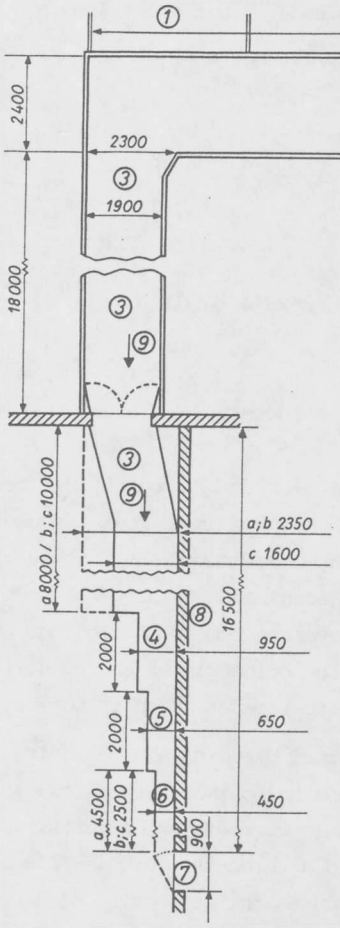
SUMMARY: We investigated the locomotion behaviour of groups of slaughter pigs driven through different Hoenderken single-file races (H. s.-f.races).
In each of the three experiment variations we formed passing groups of 1 to 10 animals. Only about 50 per cent of the pigs passed the single-file race. The passing refusal behaviour of the whole group occurred most frequently in all variations. Wide driving ways had a favourable influence on the locomotion behaviour of the pigs but they caused stoppages when entering the single-file race. Narrow driving ways to the races had a guiding function. Long final sections (≥ 4 m) induced the pigs to enter the single-file race. The average number of pigs per passing groups was about 5 pigs. The results of this experiment show that the function principle of the H. s.-f.race under the given driving mode must be called in question because it is impossible to separate pigs in motion.

INTRODUCTION: Single-filing of pigs out of a group plays an important role in animal breeding and marketing as well as in the premortal field. From the ethological point of view, there has been no optimal method for single-filing with respect to construction and technology so far. Moreover, there are only sporadic experimental results or references available in literature on this field. HOENDERKEN (1976) introduced a three-step single-file race which has been appreciated all over the world up to now, and in many slaughter houses the projecting of single-file races is based on this method.
The functional principle, however, must relatively often be changed due to adjustments to slaughter house conditions. Practical investigations showed that the function of single-file races could only be maintained by exposing the animals to strong stress promoting driving means (electrical driving stick). GRANDIN (1982a, b) referred to similar problems from the ethological point of view. Proceeding from these observations definitive investigations should be carried out, dealing with the behaviour of pig groups driven through modified Hoenderken single-file races. It should be the objective of the experiments to investigate the practical relevance of the H. s.-f. race from the ethological point of view or to effect its further improvement.

MATERIALS AND METHODS:

Equipment: The three experimental driving races which are to be investigated and situated in a closed experimental box were different in the width of the driving way or/and the length of the final single-file section (Figure 1) and were covered with black tarnished metal sheets. The driving way as well as the single-file race were completely illuminated by halogen bulbs. The average illumination intensities measured in three places inside the experimental box differed from 110 to 416 lux.

Realization of the experiments: After the pigs stayed in a resting pen for 2 hours groups of 10 pigs (random samples) were brought to the starting pen for settling for a period of 60 seconds. After this, the experiment supervisor drove the pig group touchlessly by means of rhythmical shouts and clapping noise (driving flapper strikes against his rubber boots) through the driving way and the experimental single-file race while standing nearly 1 m behind the last pig.
Measured time criteria:
- time from start (≙ first pig entered the experimental box) until the last pig of the group entered the box
- time from start to the moment when the first pig (the one that enters the single-file section first) entered the 1st, 2nd and final section of the single-file race
- time from start until all pigs of the group passed the exit (≙ fixation of the position number at the exit).
This time comprises the latency time from the start-sign up to the entering of the experimental box (by the pig) as well as the time all pigs between the second and tenth of the group need to get through the driving way and the single-file race.



① resting pen
② starting pen
③ driving way — length — width
a) variation I (vI) 8.00 m 2.35 m
b) variation II (vII) 10.00 m 2.35 m
c) variation III (vIII) 10.00 m 1.60 m
④ single-file section 1
a; b; c) variations I; II; III 2.00 m 0.95 m
⑤ single-file section 2
a; b; c) variations I; II; III 2.00 m 0.65 m
⑥ single-file section 3 (final section)
a) variation I 4.50 m 0.45 m
b; c) variations II; III 2.50 m 0.45 m
⑦ exit door
⑧ experimental box
⑨ passing direction

Figure 1: Setup of the experimental Hoenderken single-file race including the driving way (ground plan)

Every single-file experiment variation was repeated 30 times on several days. "Passage willingness", passage refusal behaviour of each individual pig and the whole group (quantity; percentage) as well as the passing time of all animals were evaluated. According to the number of passing pigs per group passage groups were formed to which each passing pig was assigned depending on its position in this group (measured at the exit). For reasons of measuring technology the exact determination of passage times had to be restricted to the above mentioned criteria. We tried to determine the confidence intervals for statistic assurance.

RESULTS AND DISCUSSION: The statistic data are described in the tables 1 to 3 (supplement 1).

Passage behaviour: The number of pigs passing the single-file race in relation to the total number of the test animals per variation (in per cent) lead to the results in the following order:

1. variation I: 50.7 per cent
2. variation III: 47.3 per cent
3. variation II: 43.7 per cent.

The occuring groups of passing animals consisted of 1 to 10 animals. The global evaluation of the full utilization of chances by the animals in taking a certain position within the group points out that variation I (except position 9 and 10), followed by variation III (advantages in position 9 and 10), had the best positional strength. Variation II can be characterized -nearly without exception- as the "least passed" variation (except positions 1, 8, 9, 10). For all variations applies the rule that position numbers and passage frequency developed in contrary directions.

Required passing times: The passing time of first animals of variation I with the shortest driving way to the first section (8.2 sec) was similar to that in variation II (8.1 sec) and lower than that in variation III (8.5 sec). On the way from the start to the single-file sections 2 and 3 lost of time was made up for (from start to section 2: vI 10.9 sec; vII: 11.5 sec; vIII: 11.6 sec; start to section 3: vI 14.5 sec; vIII: 15.1 sec; vII: 16.2 sec). Best passing time was registered for variation I through the single-file sections 1 and 2 as well (section 1: vI 2.7 sec; vIII 3.1 sec; vII 3.4 sec; section 2: vI 3.7 sec, vIII 4.1 sec, vII 5.3 sec.). The final section of variation I is 2 m longer than those of variations II and III. For this, their passing times are not

Supplement 1:

Table 1: The sequence of the average passing time of the first pig of passing groups through the experimental box including the Hoenderken single-file races [1]

sequence	passing time from start			
	(n) to section 1 (x)	(n) to section 2 (x)	(n) to section 3 (x)	(n) to exit door
1.	(30) vII (8.1 sec) [a]	(30) vI (10.9 sec) [b]	(29) vI (14.5 sec) [b,c]	(25) vIII (24.0 sec) [c]
2.	(30) vI (8.2 sec) [a]	(30) vII (11.5 sec) [b]	(28) vIII (15.1 sec) [b,c]	(24) vII (26.8 sec) [d]
3.	(30) vIII (8.5 sec) [a]	(30) vIII (11.6 sec) [b]	(27) vII (16.2 sec) [c]	(22) vI (28.4 sec) [c]

x) The distances from start to section 1 were 8 m in vI and 10 m in vII and vIII.

Table 2: Sequence of the average passing time of the first pig of passing groups through the experimental Hoenderken single-file races [1]

sequence	passing time through			
	(n) - section 1	(n) - section 2	(n) - section 3	(n) - whole single-file race
1.	(30) vI (2.7 sec) [a]	(29) vI (3.7 sec) [a]	(25) vII (10.1 sec) [b]	(25) vIII (16.1 sec) [b]
2.	(30) vIII (3.1 sec) [a]	(28) vIII (4.1 sec) [a]	(24) vIII (10.3 sec) [a,b]	(24) vII (19.0 sec) [b]
3.	(30) vII (3.4 sec) [a]	(27) vII (5.3 sec) [a,b]	(22) vI (13.4 sec) [b]	(22) vI (20.0 sec) [b]

1) Valid for table 1 and 2:
- Tests between time differences between sections and the whole distance within variants ($\alpha = 0{,}05$).
- Equal coefficients = non-significant differences ($\alpha = 0{,}05$); Unequal coefficients = significant differences.
- Time differences between variants are all non-significant.

Table 3: Touches with the electrical driving stick per animal respectively the number of withdrawal reactions per pig (investigated in enterprise B and C; $\bar{x} \pm s_{\bar{x}}$)

enterprise		withdrawals	
	(n) touches per pig	(n) section 2	(n) section 3
B	(42) 14.2 ± 9.2	(67) 0.67 ± 1.06	(66) 1.1 ± 1.4
C	(161) 2.0 ± 1.9	(58) 0.2	

directly comparable with variations II and III. The first pigs in variation II were the quickest from the start to the first section (8.1 sec) and also through the final section (10.1 sec). But they were slower than the animals in variation I and III through the section 1 and 2. The first animal in variation III needed most time from the start to the first single-file section (8.5 sec). From the start to the final section they were placed second (15.1 sec) and to the exit first (24.0 sec). Through the whole single-file race the first pigs of variation III were the quickest (16.1 sec) compared to variation II (19.0 sec) and variation I (20.0 sec). This sequence applies also to the passing times of the first pigs through the whole experimental box. There were large deviations in all time values (individual pigs, groups, single-filing, total distance), especially for the first pig in the final section. In spite of these large deviations there was an increase of passing times of the first pigs through single-file sections 1 to 3 (significance of the passing time of variation I from the sections 1 and 2 (2 m) to 3 (4.5 m) and the total passing time; - variation II from section 1 (2 m) to section 3 (2.50 m) and total passing time; - variation III from section 1 as well as from section 2 (each: 2 m) to the total passing time (increased exploration behaviour, conflict behaviour)).

Investigations in practice: We observed single-filing processes under practice conditions in three modified H.-f. races. In enterprise C 2.0 (± 1.9) touches per animal with the electrical driving stick (each contact lasted 3 seconds) were applied. In enterprise B, each of the observed pigs got an average of 14.2 (± 9.2) touches with the driving stick. In all three enterprises 50 to 80 per cent of the predensified pigs turned back and went to the entrance shortly after they entered the starting pen in the widest single-file section. Only 3 to 5 animals (n = 42) passed the single-file race in enterprise B unshocked. We registered 1.1 (± 1.4; n = 66) withdrawal reactions within the final section and 0.67 (± 1.06; n = 67) withdrawal reactions in single-file section 2 in enterprise B. In enterprise C the average withdrawal rate was 0.2 in single-file section 2. Thus we can say that there are general, groupmodified alternative behavioural patterns which are characterized by pronounced exploratory behaviour, increasing group densities, neglect of individual floor space, fear of unknown environmental situations, such as flowing water, restrainer, angles of driving ways and others.

CONCLUSIONS: Our experiments in experimental Hoenderken single-file races made us conclude the following:
- Only about 50 per cent of the test pigs passed the single-file races. The passage groups that occured con-

sisted of 1 to 10 animals.

- In all variations passage refusal behaviour occurred mostly in complete groups, compared with the occurence freqency of the other passing group sizes.
- Narrow driving ways to the races had a guiding function for the animals when they entered the single-file sections (variation III, best passage times).
- Long final sections ($\geq$ 4 m) induced the pigs to pass the single-file race, provided that the pigs had passed the sections which are before it (variation I, best passing behaviour of the test animals through the three sections).
- The average number of pigs per passage group was 5.
- The passing time per section required by first animals increased from the first to the last section in all three variations (deterrence effect, conflict behaviour, jam situations, withdrawals, increased exploratory behaviour).
- All passage times were marked by large deviations caused by withdrawals, acute exploratory behaviour, occurrence of aggregations of first and following pigs within one group especially in the final single-file section.

The results of the experiments can be confirmed by investigations in modified Hoenderken single-file races under practical conditions.

The results of our investigations show that an effective management of Hoenderken single-file races in practice and under the extremely variable and the given driving conditions have to be called in question as it is impossible to single-file larger groups of pigs out of a motion and without any stress-promoting driving means. Stoppages, jam situations, aggregations, increased exploratory behaviour and passage refusals occur especially in the second and final single-file sections. The management of already existing H. s.-f. races can not be improved at the moment for general application as length and width measurements of each single-file section as well as the sizes of driven groups are typical for slaughter houses and, thus, extremely different.

In general we should concentrate on the following:

- to cover the walls of single-file races and total illumination in order to avoid shaddows on driving ways and in single-file races,
- to make the Hoenderken single-file race blockable in the back as the single-filing of all animals of one group out of a motion is not yet possible,
- to design narrower and shortened driving ways,
- an extended final section of the single-file race (at least 4 pigs),
- to single-file groups of about 10 pigs as the average number of pigs in passing groups was 5 under "pressureless driving". The driving person can reach all animals without difficulties.
- deliberate reduction of driving pressure in jam situations in the final section,
- adjustment of the single-file races to the slaughter and production process under consideration of ethological behavioural mechanisms in the technological basic conception.

The results we gaimed and which are not yet satisfactory make it necessary to continue research work steadily so as to develop new single-filing concepts of practical relevance.

REFERENCES:

GRANDIN, T. (1982a): Understanding Hog Psychology Simplifies Handling. - Vet. Med./Small Anim. Clin. 77: 267 - 271

GRANDIN, T. (1982b): Livestock Psychology and Handling Facility Design. Great Plains Beef Cattle Handbook, Dept. of Anim. Sci. Univ. of Illinois, GPE 5001: 1 - 6

HOENDERKEN, R. (1976): Ein verbessertes System für das Treiben von Schlachtschweinen zum Restrainer. Die Fleischwirtschaft 56: 838 - 839