Pasture-Based Swine Management: Behaviour and Performances of Growing-Finishing Pigs

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Abstract
A pasture-based swine management (PBSM) trial was conducted in Piemonte (N-W Italy) to study the performances and the carcass yield of 16 hybrid pigs (8 castrated males and 8 females; average initial weight: 90 kg). Animals were allowed to forage pea, clover, beet and alfalfa pastures for 170 days in a crop-pasture rotation on different paddocks. A concentrate was fed to supply 50% of estimated energy requirements. Forage dry matter intake (DMI) ranged from 0.32 kg/day (alfalfa) to 2.85 kg/day (pea), depending on the period and forage type. Pigs were weighted every 30 days and at slaughtering; average daily gain (ADG) was 0.29 kg. The stocking rate (SR) ranged from 109 kg/ha LW (clover) to 2347 kg/ha LW (pea). Data collected at slaughtering (average final weight: 141 kg) were: hot carcass weight and yield, lean and fat cuts weight, backfat thickness, pH_{45} and pH_{24}. The statistical analysis (ANOVA of SPSS) did not show differences between males and females. Results showed that PBSM should be especially appealing to limited-resource farmers due to low inputs needed; pasture can be used to replace 50% of the nutritional needs, helping to save on grain costs, without affecting carcass characteristics.

Keywords: pig management, nutrition, forage, crop-pasture, pig performances

1. Introduction

Pig meat and derived meat products consumed in Italy are mainly obtained from animals raised under intensive conditions, but in the last few years, consumers have become more concerned about questions such as ethical forms of animal production, animal welfare and ecological production [1]. Thus, extensive production of the pigs under ”traditional” conditions, and fed on natural feeds, has appeared as one of the main targets for many pig breeders [2]. Outdoor pig production systems come in many forms; in these systems, pigs have the theoretical potential to forage for a range of different feedstuffs, and the nature of the diet might affect performances and product quality [3,4]. This investigation was primarily designed to explain the performances and the effects on some carcass characteristics of pigs partially fed with a concentrate and grazing for a 6-months period on sowed pea, clover, beet and alfalfa in a crop-pasture rotation.

2. Materials and methods

The trial was conducted in a private farm of N-W Italy on 16 hybrid pigs (8 castrated males and 8 females). A 3.8 ha area, which included 0.7 ha of forest, was subdivided with electric fences into 20 paddocks. Pigs were allowed to forage pea (from May to mid July), clover (from mid to end July), beet and alfalfa (from August to end of the trial) in a crop-pasture rotation for 170 days. In each paddock animals had free access to a water pond

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and to the forest. As suggested by [5], a concentrate was fed to supply 50% of the estimated daily energy requirements [6]; the concentrate was allocated daily in a trough with simultaneous access for all pigs. Composition and characteristics of the concentrate are reported in "Table 1".

Table 1. Composition and main characteristics of the concentrate

	%
Cracked corn	55
Barley	15.5
Soybean meal	12
Lineseed	2.5
Wheat bran	11
Minerals/vitamins	3.9
Lysine + methionine	0.1
Dry matter	87.2
Crude protein	15.5
DE (MJ/kg DM)	14.5

During the pasture period, the following parameters were measured in each paddock: as fed and DM forage yield (kg/m^2), forage DM (%), total DM (kg), available DM (kg/head and kg/day/head). Total and daily dry matter intake (DMI) of forage were calculated as difference between offered and refused forage DM, at the beginning and at end of the grazing period respectively. Pigs were weighted at the beginning of the trial (average initial LW: 90 kg), every 30 days and at slaughtering (average final LW: 141 kg). The data were used for calculating the stocking rate (SR) on each paddock (kg LW/ha) and the average daily gain (ADG) of castrated males and females.

The pigs were transported from the farm to the abattoir (1 km) and left for fastening in the lariage for 24 h. Data collected at slaughtering were hot carcass weight and yield, carcass lenght and backfat thickness (Introscope); after carcass dissection, the weights of individual lean cuts (neck, ham, shoulder and loin) and adipose cuts (backfat, belly, collar fat, flare fat) were recorded. Within 45 minutes after slaughtering and after 24 hours of chilling at 4°C, pH was measured on *Longissimus dorsi* muscle (pH_{45} and pH_{24}). The results were analysed with ANOVA of SPSS (2007) [7], considering sex as fixed effect.

3. Results and discussion

The DMI of the concentrate increased from 1000 to 1300 g/head, according to the increased LW of pigs. Forage DMI ranged from 0.3 kg/day (alfalfa) to 3.0 kg/day (pea), depending on the period and the forage type. Differences in forage DMI changed according to availability, quality and palatability. Pea plants were the most consumed forage; the highest pea DMI values were observed during blooming. At late vegetative stage, only seeds and few leaves were eaten by animals. Beet leaves were totally eaten by pigs; at late vegetative stage, also roots were occasionally consumed. Due to the high amount of fibre and reduced digestibility, clover and alfalfa were little consumed. For both forages, the highest DMI values were observed at early vegetative stage (stem length: < 15 cm).

During summer, the DMI of all forages decreased substantially and pigs spent most of the daytime in the forest or in the ponds, adding roots and insects to the forage + concentrate diet. From September on, pigs increased the DMI of all forages, reaching approximately the same values of the springtime.

"Table 2" shows the total yield (as fed and DM) and the total and available DM of each forage during the whole trial.

"Table 3" shows the total, minimum and maximum, and daily DMI (kg/head) of each forage, and the average and minimum and maximum stocking rate (SR) (kg LW/ha).

During the trial, the stocking rate (SR) ranged from 108.6 kg/ha LW (pigs on clover at end of July) to 2347.4 kg/ha LW (pea, beginning of June). Average SR was 662 kg/ha LW.

Average daily gain (ADG) of all pigs was 0,29 Kg/d. Even if the best ADG was performed by a female (0.36 kg/d), no statistical difference was observed for ADG between females and castrated males (0.31 vs. 0.27 kg/d).

Some investigation indicate that growth rates obtained in an outdoor system can be comparable to growth rates of indoor production [5, 8, 9]. Because of the lack of comparative data on pigs slaughtered at 140 kg LW, the present results were compared with the performances of pigs reared indoor in the same farm and fed 100% of the concentrate used in this trial. ADG of outdoor pigs was 46% of the average values observed on pigs reared indoor; however, some animals performed better (60% of ADG of pigs reared indoor),

showing the possibility of further improvement of the pasture-based pig management in this farm. Due to the lower ADG, the grazing pigs reached the same slaughtering weight of indoor pigs 78 days later.

"Table 4 and 5" show the slaughtering results for castrated males and females. The consequences on carcass traits of growing-finishing pigs reared on sowed forages varies between studies. In this trial, no statistical differences were observed for carcass traits between castrated males and females. However, castrated males showed a slightly better hot carcass yield, higher percentage of total fat cuts and ham weight than females. Compared with pigs reared in the same farm, the average hot carcass weight and yield of both groups of animals showed lower values (105.5 vs. 119.1 kg and 74,9 vs. 82,7% respectively). The decrease of pH values from 45 minutes to 24 hours after slaughtering indicate a normal glycolysis for both groups of animals, and confirm that muscle metabolism and glycolytic capacity can be positively influenced by grazing [10].

Increased backfat thickness has been reported by some authors [11, 12], whereas others found no significant influence [13]. Moreover, a decreased carcass fatness in relation to a lower growth rate of outdoor pigs has been reported [14, 15]. These discrepancies may be explained by the differences in climatic conditions together with the feeding intensity used in the studies. In this trial, the backfat thickness did not statistically differ between castrated males and females, but the average value of both groups was much lower than backfat thickness observed on pigs reared indoor and slaughtered at the same weight (20.6 vs. 29.2 cm).

Table 2. Total yield, DM yield, total and available DM of forages

	Yield Kg/m^2	DM %	DM yield kg/m^2	Total DM kg	Available DM kg/head	Available DM kg/d/head
Pea	1.6	30.3	0.50	516.0	151.6	7.2
Clover	0.9	21.2	0.19	924.0	92.4	13.2
Beet	1.4	7.0	0.10	85.6	10.4	1.4
Alfalfa	0.3	25.4	0.05	370.5	46.3	4.7

Table 3. Forages DMI and SR (average and minimum – maximum values)

	Total DMI kg/head	Average DMI kg/d/head	Min – Max DMI kg/d/head	SR kg/ha LW	Min - Max SR kg/ha LW
Pea	11.7	1.7	0.6 – 3.0	945.6	114.4 – 2347.4
Clover	8.6	1.2	1.2 – 1.2	108.6	108.6 – 108.6
Beet	10.5	1.4	0.7 – 1.7	619.6	489.4 – 672.8
Alfalfa	5.6	0.5	0.3 – 0.7	192.3	170.6 – 216.9

Table 4. Effect of sex on hot carcass weight, yield and lean and fat cuts

	Castrated males		Females	
	Kg	%	Kg	%
Live weight	142.5±12.4		139.5±10.7	
Hot carcass weight	107.4±7.6		103.5±7.2	
Hot carcass yield		75.5±4.5		74.3+4.3
Lean cuts Ham	25.0±3.5	23.2±2.4	23.7±2.3	22.8±1.5
Neck	16.1±1.4	15.0±1.0	16.0±1.6	15.5±1.3
Loin	7.7±0.9	7.2±0.7	8.0±0.7	7.7±0.7
Shoulder	16.5±1.9	15.3±1.4	16.2±1.0	15.7±0.8
Total lean cuts		60.7±3.7		61.7±2.8
Fat cuts Belly	13.2±3.4	12.5±3.3	12.5±3.3	12.0±2.7
Backfat	8.9±1.2	8.3±1.0	7.5±2.8	7.2±2.8
Jowl	3.5±0.6	3.3±0.6	3.2±0.4	3.1±0.3
Flare fat	1.7±0.5	1.6±0.5	1.4±0.5	1.3±0.4
Totale fat cuts		25.5±2.7		23.7±4.1

Table 5. Effect of sex on carcass measurements and pH of *M. Longissimus dorsi*

	Castrated males	Females
Carcass lenght (cm)	90.8±3.1	89.5±2.7
Backfat thickness (mm)	21.3±4.6	19.9±5.0
pH_{45}	5.98±0.17	5.87±0.26
pH_{24}	5.46±0.05	5.46±0.06

4. Conclusions

The study suggests that the potential to increase nutrient intakes from pasture exists, but it requires a better understanding of nutrient utilization, voluntary intake and diet selection of different plant species under grazed conditions. Due to low inputs needed, pasture-based swine management should be especially appealing to limited-resource farmers, and the results of the trial show that pigs grazing sowed forages in a crop-pasture rotation can perform well when: 1) at least 50% of the energy requirements are supplied by a concentrate; 2) forages are grazed at early vegetative stage; 3) animals can recover in forest shadow or water ponds during the hot season. Even if there are possibilities for further improvement of the pasture-based pig management, the breeding period of pigs reared outdoor is longer than indoor, but pasture can be used to replace 50% of the nutritional needs, helping to save on grain costs, without affecting carcass characteristics.

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