EFFECT OF PHYSICAL FORM OF DIET ON PIGLETS' PERFORMANCE AFTER WEANING

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SUMMARY

Research was carried out on weaned crossbred piglets to compare two feeding methods. Both before and after weaning the same three phase feeding program was conducted both for the control and the treatment group in terms of types of piglet feed. However, while the control group was fed dry feed for 1 week after weaning continued with liquid feed for the remaining time, the treatment group had liquid feed for the whole nursery period. The control (dry fed) and treatment (liquid fed) groups consisted of 60 piglets each, 120 piglets in total. Feed intake, feed conversion ratio, body weight and uniformity of growth were measured. Overall average daily feed intake was in the control and trial group 680 g and 850 g/piglet, respectively. For the first week these values were 201 g and 286 g, respectively. Feed conversion ratio was 1.56 kg/kg and 1.7 kg/kg for the control and trial group. For the first week after weaning the values were 1 kg/kg and 1.16 kg/kg. Pre-weaning daily weight gain was higher in the dry fed group than in the liquid fed group, 273 vs. 252 g/day, but tendencies changed after weaning. Overall daily weight gain after weaning for liquid fed group exceeded that of dry fed group, 465 g/day and 421 g/day, respectively. By the end of the trial piglets fed liquid for the entire nursery period became more uniform than piglets started with dry feed for one week after weaning. Regarding only the first week we can conclude that feeding piglets with liquid diet right after weaning helps challenged piglets get through this critical period more easily but based only on this single research we can not state that our overall results are the consequence of the different feeding methods.

ÖSSZEFOGLALÁS

Nesz, P. – Nagyné Kiszlinger, H.: A TAKARMÁNY FIZIKAI ÁLLAPOTÁNAK HATÁSA A VÁLASZTOTT MALACOK TELJESÍTMÉNYÉRE

A szerzők két takarmányozási mód hatását vizsgálták választott nagyfehér x lapály hibrid ártánymalacokon. Választás előtt és után is ugyanazt a háromfázisú takarmányozást alkalmazták mind a kontroll-, mind a kísérleti csoportban: prestarter takarmány a választást követő 1-18. napon, starter takarmányt a 16-33. napon és malactakarmányt a 30. naptól a vizsgálat végéig. A kontrollcsoport ugyanakkor a választást követő első héten szárazon kapta a takarmányt, majd folyékonyan a nevelés befejezéséig. Ezzel szemben a kísérleti csoport a nevelés teljes időtartama alatt folyékonyan kapta a takarmányt. A kontroll- és a kísérleti csoport is 60 malacból állt, összesen 120 állatot vontak a vizsgálatba, melyeket 26, harmadik és negyedik fialású koca almaiból választottak ki. A vizsgált tulajdonságok: napi takarmányfelvétel, takarmányértékesítés, napi súlygyarapodás és az állomány homogenitása testsúly tekintetében. A vizsgálat egész időszakát tekintve a napi takarmányfelvétel 680 g és 850 g/malac volt a kontroll- és a kísérleti csoportban. A választást követő első héten ugyanez 201 g és 286 g volt. A takarmányértékesítés 1,56 kg/kg és 1,70 kg/kg volt a kontroll- és a kísérleti csoportban. A választást követő első héten ugyanez 1 kg/kg és 1,16 kg/kg. A választás előtti napi súlygyarapodás a kontrollcsoportban nagyobb volt, mint a kísérletiben, 273 vs. 252 g/nap, de ez a tendencia a választást követően megfordult. A nevelés teljes tartamát tekintve a végig folyékony takarmányt fogyasztó malacok átlagos napi súlygyarapodása felülmúlta a kontrollcsoport malacait, 465 g/nap vs. 421 g/nap. A vizsgálat befejezésekor a végig folyékony táppal etetett malacok súlya kiegyenlítettebb volt, mint a nevelést száraztakarmánnyal kezdő malacoké. A választást követő első hét eredményei igazolják, hogy a folyékony takarmányozás segíti a malacokat átjutni a kritikus időszakon, azonban a vizsgálat teljes időtartamára kapott eredmények megerősítéséhez ismételt vizsgálatokra van szükség.

INTRODUCTION

The weaning age of piglets in the EU averages 28 days which is considered economical however farmers face several problems of diverse physiological background.

The act of weaning itself, the separation from the sow is a most stressful event in the life of piglets which is followed by a series of phenomena including reduced feed intake, stagnating growth or even decreasing body weight. These symptoms often coincide with impaired health status confirmed by many authors (*van der Meulen et al*., 2010; *Campbell et al*. 2013; *McLamb et al*., 2013).

Under natural conditions piglets are weaned gradually and significantly later than under farm circumstances (*van der Meulen et al*., 2010). By the age of 17-20 weeks wild piglets are considered to thrive solely on solid food (*Faragó*, 1994; *Whiting and Pasma*, 2008). The process of separation is initiated by both sow and piglets: the former restricts access to the udder, the latter exhibit decreasing interest in suckling (*Whiting and Pasma*, 2008). From the age of 3 weeks milk from the sow is not sufficient to cover the needs of piglets. Thus, parallel to reducing milk production wild piglets explore their environment looking for edible roots, grass, weeds, insects etc and, of course, water (*Faragó*, 1994; *Früh et al*., 2014). In this way their gastrointestinal tract is adapting continuously to breaking down nutrients coming from sources other than sow milk.

On the contrary, post weaning growth drop, called also post weaning growth check is well known with piglets reared on intensive farms. Digestive enzyme activities rapidly increase from the fourth weeks of age (*Corring et al*., 1978) but the function of the stomach and small intestine is not yet fully developed. The activity of pancreatic enzymes like trypsin or chymotrypsin increases (*Corring et al*., 1978), however, right after weaning that of lipase was decreasing in the study of *Jensen et al*. (1997). Besides this there is a period of several days where the activity of lactase is declining but that of amylase and maltase has not yet reached its maximum which limits the digestion of dietary starch of plant origin. This period unluckily coincides with the time of weaning when young animals have to transit to the solid diet. Piglets often experience hunger then overeat without digesting feed properly and so offering medium for pathogenic bacteria to grow (*Sorensen et al.,* 2009). As a consequence challenged piglets suffer much from diarrhoea which is a defensive mechanism helping piglets remove undigested feed from the intestine as described by *Gadd* (2011).

Another problem that can significantly contribute to the setback of young animals is dehydration caused by either insufficient water intake or diarrhoea mentioned before. There is a strong association between water consumption and feed intake, thus it is of vital importance to get them drinking. While a portion of weaned piglets prefers water to solid feed right after weaning, there are animals that may thirst as long as 24 hours. Liquid feeding is a possible solution to avoid dehydration. *Russel et al*. (1996) found that the average daily feed intake of piglets fed liquid was significantly higher than that of piglets fed dry for the overall 28-day-period after weaning, partly due to increased wastage. Average feed conversion rates were not significantly different between the two methods. Daily weight gain, however, was found greater in the liquid feed group as well as total water usage.

Kim et al. (2001) reported similar results with piglets that had no access to creep feed prior to weaning. In their trial piglets fed liquid had 44% higher average daily weight gain with decreasing difference compared to piglets fed dry feed as the pigs aged. At the end of the nursery period liquid fed pigs weighed 2-4 kg more than dry-fed pigs. In an other research (*Han et al*., 2006) weaned piglets were assigned to three treatments: first, having dry feed for 40 days, second, having liquid feed for 10 days followed by dry feed for 30 days and third, having liquid feed for 20 days followed by dry feed for 20 days. Liquid fed piglets were superior to dry-fed piglets regarding daily feed intake for the overall period explained by the fact that liquid fed piglets did not have to learn separate feeding and drinking. The daily weight gain of the liquid fed groups was 4.9-16.8% higher than that of dry-fed group. The feed conversion ratio for the second group was the highest.

In the present study two feeding strategies were compared: feeding weaned piglets dry pelleted feed for 1 week followed by liquid feeding vs. feeding them liquid feed over the entire nursery period. The former was the general feeding strategy in the nursery. Feed intake, feed conversion ratio, daily weight gain and uniformity of growth were evaluated.

MATERIAL AND METHODS

Research was carried out on castrated Large White x Landrace crossbred weanlings. The control (dry fed) and the treatment (liquid fed) groups consisted of 60 piglets each, 120 piglets in total from 26 sows of parity 3 and 4. Randomly selected piglets were ear tagged and weighed individually twice in the farrowing unit, once 4 days prior to weaning and the second time on the day of weaning. Then all piglets were placed in the same nursery, divided into 4 pens with a floor space of 22 m^2 each. The flooring was slatted and a combination of plastic and concrete floor. Initial nursery temperature was 28°C in the barn. As environment enrichment material we provided hemp ropes.

Each pen was equipped with a sensor-controlled two sided feeder trough with a length of 175 cm, 8 nipple drinkers, 4 of them at a height of 32 cm and 4 at 48 cm. In addition a round feeder was also placed into the pen and filled with water for a week after weaning.

In the farrowing unit supplemental feeding started at the age of 3 days with liquid milk replacers dispensed in sensor-controlled piglet trough. Milk replacer was provided till the 18^{th} day after birth. From the 7^{th} life day prestarter was offered in round feeders.

At the age of 4 weeks piglets were weaned. After weaning the same three phase feeding program was conducted both for the control and the treatment groups in terms of types of piglet feed with pre-starter being the first, followed by starter and ended with piglet 3F (*Table 1*.). However, while the control group was fed dry feed for 1 week after weaning continued with liquid feed for the remaining time, the treatment group had liquid feed for the whole nursery period. The water to feed ratio was 2.5:1 in both groups. Through the sensor in the automatic feeder a computer checked every 30 min between 5:00 and 12:00 am and every 60 min between 14:00 and 24:00 pm whether there is still feed in the trough. All piglets were given *ad libitum* access to feed and water.

Table 1.

Chemical composition of experimental diets in nursery

	Pre-starter	Starter	3F piglet (1)
Feeding interval, day (2)	1-18	16-33	30-
Ingredient (3)			
Crude protein, % (4)	19.5	17.5	16.5
Crude fat, % (5)	6.1	4.9	4.0
Crude fiber, % (6)	2.5	3.0	4.0
Crude ash, % (7)	5.0	5.0	4.5
Calcium, % (8)	0.61	0.6	0.54
Phosphorus, % (9)	0.55	0.50	0.44
Salt, % (10)	0.30	0.20	0.19
Vitamin-A, NE/kg	16000	14452	5500
Vitamin-D_3, NE/kg	2000	2000	660
Vitamin-E, mg/kg	150	100	139
Lysine, % (11)	1.47	1.37	1.18

1. táblázat A kísérletben etetett takarmányok kémiai összetétele

3 F malactáp (1); etetés időtartama, nap (2); összetevő (3); nyersfehérje, % (4); nyerszsír, % (5); nyersrost, % (6); hamu, % (7); kalcium, % (8); foszfor, % (9); só, % (10); lizin, % (11)

During the experiment piglets were individually weighed every 3 days, in total 15 times (2 times in the farrowing unit and 13 times in the nursery). Average weaning weight for the trial group was 9.2 kg, that for the control group 8.9 kg. Feed intake could only be recorded for pen, not individually, and on a dry matter basis for both groups. Two animals from both groups were removed because of leg problems; average feed intake was corrected accordingly. Feed conversion ratio was calculated for the nursery period. To assess uniformity of growth CV% was computed for weight at 3-day intervals. Average daily weight gain was calculated for the whole experimental period and for each interval extended by 3 days, as well.

The statistical analysis of the data was carried out by SAS 9.1.4 using MEANS for descriptive statistics, covariance analysis for comparison of growth of control and treatment group. In the model weaning weight was used as covariate and the group as fixed effect.

RESULTS AND DISCUSSION

Feed intake

The average feed intake for the control group was 27.3 kg while that of the experimental group exceeded it by 24.2% (33.9 kg) during the trial in the nursery. The average daily feed intake was 680 g and 850 g/piglet in the control and trial group, respectively. Focusing solely on the first week after weaning, the differ-

ence is more striking. The average daily feed intake of piglets fed dry was 200.5 g while that for liquid fed piglets was 286 g, which means a superiority of 42.6 % compared to the control group. As we did not have opportunity to measure feed intake individually, the difference cannot be proven statistically, however it is remarkable.

In the literature we did not find similar research where piglets were fed the way as in our trial group, so in the following discussion – also in case of the traits feed conversion ratio and average daily gain – the first week after weaning could only be taken into account.

Our result for the first week after weaning is in accordance with that of *Russel et al*. (1996) who attributed this difference primarily to feed wastage in the liquid fed group. In their experiment daily feed intake of liquid fed piglets was 286 g higher than that for dry fed group in the first week. *Kim et al*. (2001) also found that average feed intake of liquid fed group exceeded that of the dry fed group during the first two weeks after weaning. Results of *Han et al*. (2006) and *Lawlor et al*. (2002) are also in agreement with our and previous findings: liquid fed piglets' average feed intake in their trials was higher by 16.8% and 12.8%, by 35.4% and 28.3%, respectively. By contrast, *Hong et al*. (2009) obtained reverse results.

Feed conversion ratio

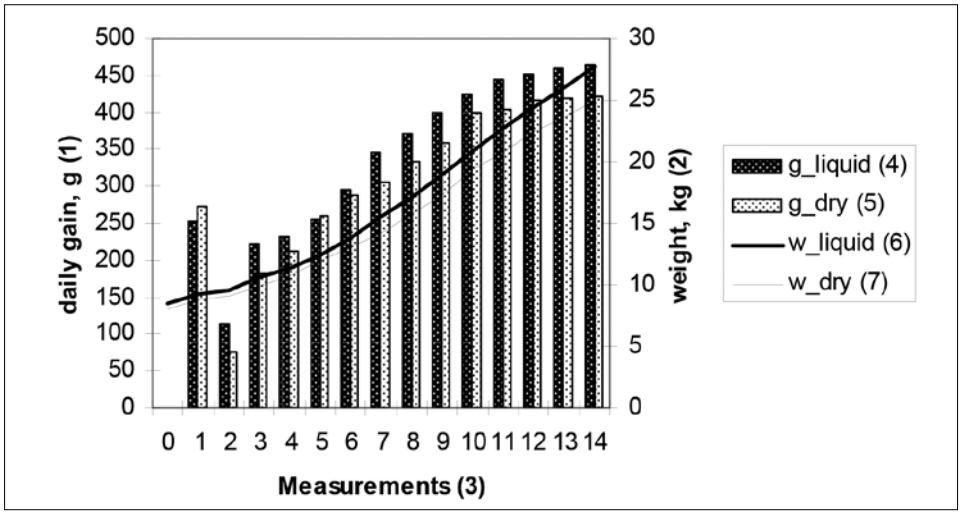
The feed conversion ratio (FCR) was found higher for the liquid fed group than for the dry fed group, 1.7 kg/kg and 1.56 kg/kg, respectively. For the first week after weaning the values are 1.16 kg/kg and 1 kg/kg, respectively. Non-significant was the difference in the study of *Russel et al*. (1996) for the first week in both trials where liquid vs. dry fed piglets had a conversion ratio of 3.47 and 3.36 kg/kg in trial 1., respectively, attributed to feed wastage, and 1.57 and 1.52 kg/kg in trial 2, respectively. Furthermore, our results are consistent with that of *Han et al*. (2006), however, they assessed lower difference between both feeding strategies. By contrast, *Hong et al*. (2009) obtained reverse results. Piglets reached an FCR of 1.05 kg/kg on a liquid diet with inclusion of rice distiller's residue and 1.41 kg/kg on fermented liquid diet depending while on dry feed 1.67 kg/kg for the first two weeks. They assume that the differences are due to reduced dietary fibre content and higher digestibility of crude protein and organic matter in the former diet.

Kim et al. (2001) and *Lawlor et al*. (2002) calculated feed conversion as average daily weight gain divided by dry matter intake. They obtained controversial results, as well. In the research of *Kim et al.* (2001) pigs fed liquid diet utilized feed better than the other group: they gained 1076 and 1061 g/kg on liquid feed, while 878 and 867 g/kg on dry feed. In latter study the values are 978 and 1167 g/kg and 587 and 778 g/kg for dry and liquid feed, respectively. Values for liquid feed are surprisingly high but remain without further explanation.

Average daily weight gain

Average daily weight gain expressed as daily weight gain related to the first weight measurements in the nursery and weight data beginning with the weight 3 days prior to weaning (measurement 0) are shown in *Figure 1*.

Figure 1. *Average daily weight gain and body weight of piglets fed liquid or dry diet*



1. ábra A folyékony illetve a száraz takarmánnyal nevelt malacok átlagos súlygyarapodása és súlya
napi súlygyarapodás, g (1); súly, kg (2); mérés (3); súlygyarapodás_folyékony (4); súlygyarapodás_száraz (5); súly_folyékony (6); súly_száraz (7)

Daily gain for the 3–day-period before weaning was higher in the dry fed group, 273 vs. 252 g/day, despite of piglets in the liquid group had significantly higher body weight initially. The difference between groups for daily gain was statistically not significant. The second pair of bars in *Figure 1.* denotes growth for the first 6 days after weaning, and the set back is remarkable both for dry and liquid fed piglets. However, it is noteworthy that piglets on liquid feed exceeded the performance of the other group probably due to better hydration trough feed. From the 15th days after weaning (6. pairs of bars in *Figure 1.*), the difference in growth remains significant except for measurement 9 and 11 ($p= 0.13$ and 0.06, respectively) until the end of experiment. The overall daily weight gain after weaning for liquid fed group exceeded that of the dry fed group, 465 g/day and 421 g/day, respectively ($p=0.012$).

Similar results were reported in the study of *Russel et al.* (1996). Although their first trial design of trough was less satisfactory, piglets on liquid feed outperformed weanlings on dry feed. With trough design change this superiority became more remarkable. In the trials of *Han et al.* (2006) the advantage of liquid feed was also clearly seen. They achieved the highest daily weight gain in the group fed liquid the first 20 days after weaning. *Hong et al.* (2009) found that a liquid diet with rice distiller's residue had a more beneficial effect on daily weight gain compared with the control diet, however it may be due to higher digestibility. The fermented liquid group performed the second best but the difference between this and the dry fed group was not significant. Results of *Kim et al.* (2001) partly confirm ours. In the hot nursery with ambient temperatures of 30°C piglets developed faster. They explain it with elevated feed intake and the absence of diarrhoea. On the contrary, in the segregated temperature nursery piglets fed dry pellet showed

more accelerated growth performance than piglets fed liquid diet. This finding is consistent with that of *Lawlor et al*. (2002) who reported moderate growth rate in the liquid fed group compared with its control.

Uniformity of growth

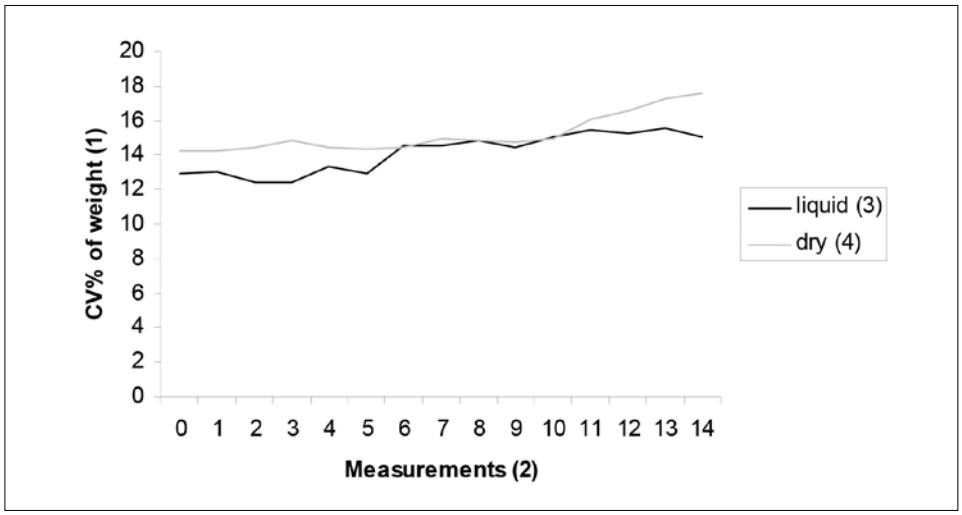
In order to achieve a homogeneous batch in terms of body weight by the end of the fattening period, it is important that pigs start with little variation in this trait. Thus we followed uniformity of growth along the nursery period as well (*Figure 2*.). The CV% of weight for piglets fed liquid after weaning was initially lower than that for the control group, 12.9% vs. 14.2 % but by the 18th day after weaning (the 6th measurement) the difference between the groups disappeared, lines intersect. From that point on to the 30th day after weaning (10. measurement) lines run parallel and close with little superiority of the dry fed group showing that variation in body weights are similar in both groups. By the end of the trial the lines parted remarkable, thus, piglets fed liquid for the entire nursery period became more uniform than piglets started with dry feed for one week after weaning.

In the previous studies uniformity of weight at the end of the nursery period depending on feeding strategy, similarly to ours, was not reported.

CONCLUSIONS

For the most time piglets were fed the same way, the difference in the physical form of the diet between groups was restricted to the first week after weaning, thus, based only on this single research we cannot state that our overall results are the consequence of that first week when control piglets were given dry feed.

Figure 2. *Uniformity of growth depending on feeding strategy*



2. ábra A testsúly homogenitása a takarmányozási módtól függően

a súly CV%-a (1); mérés (2); folyékony (3); száraz (4)

However, regarding only the first week we can conclude that feeding piglets liquid right after weaning helps challenged piglets get through this critical period more easily.

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