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Effects of dietary millet grain on performance, plasma metabolites and intestinal health in piglets

Nicoleta Aurelia LEFTER*, Mihaela HĂBEANU, Anca GHEORGHE, Lavinia IDRICEANU, Cristina TABUC

NATIONAL RESEARCH & DEVELOPMENT INSTITUTE FOR ANIMAL BIOLOGY AND NUTRITION-BALOTESTI, ROMANIA

*Corresponding author: nicoleta.ciuca@ibna.ro

INTRODUCTION

Millet (*Panicum miliaceum*), has resistance to pests and diseases, short growing season, and productivity under drought conditions compared to triticale and other major cereals (Devi et al., 2011). Previous studies consideres millet grain an important crop for both human and animal nutrition (Ahmed et al., 2013) and it was recommended as a suitable energetically source for birds (Adeola et al., 1997; Davis et al., 2003; Garcia and Dale, 2006; Hidalgo et al., 2004; Plavnik et al., 2002). However, there is still a lack of published information on the effects of feeding millet grain as substitute of cereals on performance and health status during critical period of weaning, when animales are subjected to a number of stressors and exposed to secondary infections caused by aggressive pathogens such as *Escherichia coli* bacteria. Conclusively, plasma metabolites and intestinal health (incidence of diarrhea, faecal microflora) are as important as weaning period is critical to the survival of piglets.

OBJECTIVE

The purpose of the study was to evaluate the effects of 25% dietary millet grain on performance, plasma metabolites and intestinal health of weaned piglets.

MATERIALS AND METHODS

Animals and experimental design

- Topigs piglets (N=40), average body weight (BW) 8.14±0.20 kg, age 21±3 days, were randomly divided into 2 groups with 2 replicate each.
- Piglets were fed with 2 isocaloric and isoenergetic diets: control (C, based on corn-triticale-soybean meal) and experimental (E, where the 25% millet replaced triticale) for 21 days.
- Feed (pelletized form) and water were given *ad libitum* to piglets for all experimental period.




Sampling and analysis

- The intake was recorded daily.
- In order to determine the performances (body weight, BW; feed intake, FI; average daily gain, ADG, feed efficiency, FE) the piglets were weight after 7 and 21 experimental days.
- Blood sample were collected at 21 days after weaning from 8 piglets per group by jugular venipuncture in heparinized vacutainer tubes (6 mL).
- The plasma metabolites (triglycerides, TG; total cholesterol, TC; high-density lipoprotein cholesterol, HDL-C; total protein, T-Pro; total bilirubin, T-Bil; albumin, Alb; uric acid, UA; creatinine, Cre; urea nitrogen, BUN; aspartate aminotransferase, ASAT; alanine aminotransferase, ALAT; gamma-glutamyl transferase, GGT; calcium, Ca; magnesium, Mg, inorganic phosphorus, IP) were determined by a chemistry analyser (Spotchem EZ SP-4430, Arkray, Japan) using commercial kits.
- The intestinal health was establish using fecal scoring system and microorganism analysis. A subjective scoring system from 1 to 3 was used to determine the severity of diarrhoea: 1=soft faeces; 2=mild diarrhoea; 3=severe diarrhoea. The incidence of diarrhoea was calculated as average number of days with diarrhea related to the total monitoring days (Hăbeanu et al., 2017). The microorganism analysis (total fungal count, TFC; bacteria (*Escherichia coli, Staphylococcus aureus and Lactobacillus spp*.), expressed as log10 of colony-forming units per gram of sample.

RESULTS AND DISCUSSIONS

Table 1. Effect of using millet grain grain on performance of weaned piglets

Items	C diet	E diet	SEM	*P-value**
No. of pigs, animals/group	20	20		
Body weight: Initial, kg	8.14	8.15	0.201	*0.984*
First week d-7, kg	9.69	9.55	0.281	*0.817*
Weaning d-21, kg	13.09	13.84	0.374	*0.358*
Average daily gain at frst week d-7, g/day	0.177	0.156	0.023	*0.609*
Weaning d-21, g/day	0.248	0.285	0.025	*0.171*
Feed intake, kg/day	0.46	0.54	0.252	*0.246*
Feed efficiency, kg feed/kg gain	1.85	1.90	0.025	*0.222*
Feed conversion, kg gain/kg feed	0.54	0.53	0.201	*0.173*
*Means within rows do not differ significantly (P>0.05).				

Pigs fed E diet had lower BW and ADG (-1.46 and -10.90) at 7 day or higher BW and ADG (+5.73% and +15.32%) at 21 experimental day comparing to control group (Table 1). FI or FE of piglets fed either E or C diet were comparable with no significant differences (P>0.05). Published data on the inclusion of millet grain in pig's diets as alternative to corn-based diets are limited (Murry et al., 1997; Lefter et al., 2018). However, up to 50% whole pearl millet seeds can be used in broiler chickens (Davis et al., 2003; Bulus et al., 2013) or laying hens (Garcia and Dale, 2006) diets without adversely affecting broiler performance.

Table 2. Effect of using millet grain on the incidence of diarrhea and feacal score

Items	C diet	E diet	SEM	*P-value**
Incidence of diarrhea:				
First week d-7	5.36	4.93	0.145	*0.733*
Weaning d-21	8.75	8.29	0.211	*0.945*
Fecal score	2.13	2.29	0.231	*0.785*
*Means within rows do not differ significantly (P>0.05).				

In our study at 7 and 21 days, the incidence of diarrhea of piglets fed either millet or triticale grain was comparable with no significant differences (P>0.05), (Table 2). The faecal score measured on a scale from 1 to 3 (1= soft faeces; 2= mild diarrhoea; 3 = severe diarrhea) was similar between the groups (P>0.05). Fecal score is an important parameter wich reflects the digestive health of piglets, a high score indicates an increase incidence of diarrhea (Wen et al., 2018).

Table 3. Effect of using millet grain on plasma metabolites

Plasma profile	Parameter	Limits	C diet	E_1 diet	SEM	*P-value**
Lipid	TG, $mg.dL^{-1}$	33-50[1]	49.38	50.25	2.583	*0.730*
	T-Chol, $mg.dL^{-1}$	67-367[2]	80.13	77.88	2.147	*0.618*
	HDL-C, $mg.dL^{-1}$	-	37.63	39.88	1.719	*0.532*
Protein	T-Pro, $g.dL^{-1}$	5.8-8.3[1]	5.60	5.41	0.068	*0.207*
	Alb, $g.dL^{-1}$	2.3-4.0[1]	3.00	2.96	0.057	*0.771*
	UA, $mg.dL^{-1}$	-	0.67	0.61	0.018	*0.162*
	Cre, $mg.dL^{-1}$	0.8-2.3[1]	1.30	1.24	0.069	*0.707*
	T-Bil. $mg.dL^{-1}$	0-0.5[1]	0.28	0.29	0.017	*0.791*
	BUN, $mg.dL^{-1}$	8.2-25[1]	8.00	8.13	0.496	*0.912*
Enzyme	ASAT, U/L	22-47[1]	41.25	41.17*	5.350	*0.995*
	ALAT, U/L	15-65[1]	64.25	63.29	3.055	*0.890*
	GGT, U/L	31-75[1]	48.67	46.55	3.124	*0.766*
Mineral	Ca, $mg.dL^{-1}$	6.8-14.8[2]	15.04	14.86	0.183	*0.648*
	Mg, $mg.dL^{-1}$	2-3.5[1]	2.43	2.60	0.106	*0.426*
	IP, $mg.dL^{-1}$	5.5-9.3[1]	7.39^{T}	8.28^{T}	0.255	*0.078*

[1]Merck Veterinary Manual 2010;[2] Perri et al., 2017.*Means within rows do not differ significantly (P>0.05). T= Tendence to be influenced by treatment.

The effect of dietary millet grain on plasma metabolites is summarized in Table 3. No significant difference was found for plasma metabolites among the C and E diets at the end of the experimental period. In addition, the obtained values were within the reference ranges (Merck Veterinary Manual 2010; Perri et al., 2017). However, we noticed a tendency for a higher IP concentration (+12%; P<0.07) in E compared to C diet. In our study, increasing the IP concentration in piglets peripheral blood is unexpected since cereal, the most common energetically ingredients used in swine diets contained unavailable phosphorus for productive use by animals due to the phytate complex (Kirby and Nelson, 1988; Selle et al., 2003). These results of our study are contrary to Murry et al. (1997) whereas the pearl millet-soybean meal diet did not affect serum IP of 35 d piglets.

Table 4. Effect of using millet grain on the faecal microflora (log10 cfu/g)

Weaning d-21	C diet	E diet	SEM	*P-value*
Staphylococcus aureus	6.89	6.86	0.085	*0.155*
Escherichia coli	10.05^{a}	9.64^{b}	0.120	*0.007*
Lactobacillus spp.	9.06	9.11	0.016	*0.554*
Total fungal count	4.20	3.83	0.128	*0.164*
a, b = significant differences between groups (P<0.05).				

The dietary millet significantry decreased the bacterial count of Escherichia coli (-4.11%, P=0.007) compared to C diet, while others bacteria and fungus reached similar values between treatments (Table 4).

CONCLUSIONS

- **Results suggest that dietary 25% millet grain has no adverse effects on performance of weaned piglets.**
- **The dietary millet grain had no adverse effects on plasma metabolites, as important markers of health status of piglets. Moreover, positively influence the inorganic phosphorus in piglet's peripheral blood.**
- **Due to the decreasing certain pathogenic bacteria such as *Escherichia coli*, millet could influence the intestinal health of piglets in the most critically period of their live.**
- **The study clearly indicate that the millet is a successful alternative grain for pig production.**

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SELECTED REFERENCES:

1. Adeola, O., and J. C. Rogler (1994.). Pearl millet in diets of white Pekin ducks. Poult. Sci. 73:425–435.
2. Ahmed S. M. S., Qing Z., Jing C., and Qun S. (2013). Millet grains: nutritional quality, processing, and potential health benefits. Comprehensive Reviews in Food Science and Food Safety. Vol.12, 2013, 281-295.
3. Davis A. J., N. M. Dale, and F. J. Ferreira (2003). Pearl millet as an alternative feed ingredient in broiler diets. J. Appl. Poult. Res. 12:137–144.
4. Devi P.B., Vijayabharathi R., Sathyabama S., Malleshi N.G., Priyadarisini V.B., (2011). Health benefits of finger millet (*Eleusine coracana L.*) polyphenols and dietary fiber: A review. J Food Sci Technol DOI: 10.1007/s13197-011-0584-9.
5. Garcia A. R. and Dale N. M. (2006). Feeding of unground pearl millet to laying hens. J. Appl. Poult. Res. 15:574–578.
6. Hăbeanu M., N. Lefter, A. Gheorghe, C. Tabuc, M. Dumitru, G. Ciurescu, M. Palade (2017). Effects of dietary peas mixed with linseed (3:1) on the growth performance, enteritis and certain serum parameter in weaned piglets. Food and Feed Research, 44 (2), 173-180.
7. Hidalgo M. A., A. J. Davis, N. M. Dale and W. A. Dozier (2004). Use of whole pearl millet in broiler diets. J. Appl. Poult. Res. 13:229–234.
8. Lefter N. A., Hăbeanu M., A. Gheorghe, M. Dumitru, C. Tabuc, L. Idriceanu (2018). Certain serum and faecal parameters of weaned piglets fed millet grain (*Panicum Miliaceum*) diet. FoodTech Congress 23-25 Oct., Novisad, Serbia. Book of abstracts p. 47. Comunicare oral.
9. Merck & Co. & Merial (Firm) (2010). The Merck veterinary manual, Merck & Co., Inc., Kenil-worth, NJ, USA.
10. Murry, A. C., R. D. Lewis, and H. E. Amos (1997). The effect of microbial phytase in a pearl millet-soybean meal diet on apparent digestibility and retention of nutrients, serum mineral concentration, and bone mineral density of nursery pigs. J. Anim. Sci. 75:1284−1291.
11. Perri, A. M., O'Sullivan, T.L., Harding, J.C.S, Wood, R.D., Friendship, R. M (2017). Hematology and biochemistry reference intervals for Ontario commercial nursing pigs close to the time of weaning. Canadian Veterinary Journal, 58(4), 371–376.
12. Plavnik I., B. Macovsky, and D. Sklan (2002). Effect of feeding whole wheat on performance of broiler chickens. Anim. Feed Sci. Technol. 96:229–236.

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