Assessment of the effects of dietary *Albanus* sorghum on some biochemical parameter in weaning piglets

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SUMMARY

Weaning is the most critical period being associated with stress generators factors for piglets. Diet is one of these factors. Sorghum need less water compared to other grain and in dry years it can replace maize grain. This study evaluated the influence of Albanus white sorghum, low content in tannins, on certain zootechnical (weight gain, WG, average daily gain, ADG and feed conversion, g feed:g gain) and biochemical parameters (cholesterol, triglycerides, lipase). During 20d a biological trial was conducted on weaning piglets Topigs, 28 ± 3 days of age, 6.95 ± 0.97 kg weight. Twenty piglets were assigned randomly to two groups: control (corn diet) fed with classical diet and experimental (sorghum diet), 31% of maize was replaced by sorghum Albanus variety. The serum cholesterol and lipase concentration were determined by spectrophotometer method. The triglycerides levels were assessed by Analyser BS – 130. The WG and ADG were not significantly different. The feed to gain ratio was closed between groups (1.43 vs. 1.58). The cholesterol concentration was significantly higher in Corn group compared to Sorghum group (>21.25%). The lipase enzyme can influence appetite and influence beneficial cholesterol and triglyceride concentration. The level of lipase was 12.18% lower while the triglycerides concentration was 0.87% higher in sorghum diet. In conclusion, although, sorghum digestibility is lower, the growth performances were not significantly altered. Except cholesterol concentration the other serum parameter did not differ significantly between groups.

Keywords**:** sorghum, cholesterol, triglycerides, protein, lipase, pigs

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INTRODUCTION

Using of alternative feedstuffs in animal nutrition became important for three reasons: from the economic point of view with emphasis on by-product and their potential for animal feeding, industrial demand for biofuel a large part of the waste industry being an option for animal feeding, and lately drought- tolerant capacity of the classical feedstuffs as corn and wheat. In the piglet's weaning period the diet can be one of the factors that can generate imbalances follow by negative effects of health status. The dietary addition of these feedstuffs must be managed properly due to certain restriction of their using at animals with incomplete development of the enzymatic equipment.

One of the options for livestock sector is sorghum grain. Sorghum is a cereal widespread throughout the globe that became more and more important, being 5th cereal produced in the world after wheat, rice, maize and barley (Thorabi & Khaksar, 2016, https://www.feedipedia.org). Sorghum need less water compared to other grain and in dry years it can replace corn grain. The nutritional composition of the sorghum is close to corn. Awika & Rooney (2004) highlighted the sorghum content in different phytochemicals including tannins, phenolic acids, anthocyanins, phytosterols and policosanols and its influences on human health. There are more than 30 species of sorghum, but only one is directed to human consumption, the others being used for animals. Due to low tannin content of modern variety (0.5%), this ingredient could be use as single cereal in monogastric diets (Mavromicalis, 2014).

This study assessed the influence of *Albanus* white sorghum (low content in tannins) comparative with *Turd*a corn, on certain zootechnical parameters: weight gain, average daily gain (ADG), feed intake (ADFI), and feed conversion (g feed:g gain) and on serum cholesterol, triglycerides and lipase concentration.

MATERIAL AND METHODS

The research protocol was developed according to Law 43/2014/ Romania. The experiment was carried out in the experimental farm of INCDBNA Balotesti.

Animals and Diets

The biological trial was conducted on 20 weaning Topigs piglets, 28 ± 3 days of age, 10 ♀ and 10 ♂, during 20d. The piglets were assigned randomly to two groups with two replications each group: control group (Corn diet) with a classical diet (corn and soybean meal) and experimental group (sorghum diet, 20%). The sorghum *Albanus* grain replaced 31% of the corn *Turda*. In sorghum diet we reduced by 2% the level of soybean

meal while an increase of L- Lysine and DL -methionine + cysteine level was necessary. The comparative nutritive characteristics of *Albanus* sorghum and *Turda* corn are shown in table 1.

Table 1. Chemical composition and nutritive value of sorghum and corn

Items *(%)*	*Turda* corn	*Albanus* sorghum
Dry matter	87.63	87.15
Crude protein	7.11	9.91
Fat	2.92	3.20
Cellulose	3.86	2.56
Calcium	0.04	0.02
Phosphorus	0.47	0.32
Metabolizable energy (kcal/kg)	3353	3317
Lysine	0.345	0.266
Met + Cys	0.367	0.344

The compound feed formulation met the requirement specified by the hybrid Topigs guide (table 2). The pelletized feed was used "*ad libitum*". The animals did not have any sign of illness and no antibiotic was used during the experimental period. The access to water was free. The animals were weighed at the beginning and end of the experiment in order to determine the changes of the growth performances.

Table 2. Composition of the compound feed (%)

Items, %	Diets	
	Corn diet	Sorghum diet
Turda corn	58.6	40.33
Wheat	10.0	10.0
Albanus sorghum	-	20.0
Soybean meal	20.0	18.0
Corn gluten	3.0	3.0
Milk replacer	5.0	5.0
Onix oil	0.05	0.07
DL-methionine	0.10	0.15
L-lysine	0.29	0.37
Calcium carbonate	1.70	1.64
Phytase	0.01	0.01
Monocalcium phosphate	0.05	0.23
Salt	0.1	0.10
Choline premix	0.1	0.10
Vitamin-mineral premix (P1+2) ‡	1.0	1.0
Analysed composition %		
Dry matter	89.30	88.96
ME (Kcal /kg) †	3272	3252
Crude protein	18.85	18.59

Lysine	1.20	1.20
Met + Cys	0.72	0.72
Calcium	0.90	0.90
Phosphorus	0.65	0.65
Cellulose	4.15	3.81
Ether extracted	2.40	2.48

† ME and amino acid contents were calculated based on feed composition. Diets were provided in two meals /day.

‡Vitamin mineral premix added at 1% to the diet contained (/kg feed): P1+2: 10000 IU vitamin A; 2000 IU vitamin D3; 30 IU vitamin E; 3 mg vitamin K3; 2 mg vitamin B1; 6 mg vitamin B2; 20 mg vitamin B3; 13.5 mg vitamin B5; 3 mg vitamin B6; 0.06 mg vitamin B7; 0.8 mg vitamin B9; 0.05 mg vitamin B12; 10 mg vitamin C; 30 mg of Mn; 110 mg of Fe; 25 mg Cu; 100 mg Zn; 0.38 mg I; 0.36 mg Se; 0.3 mg Co; 60 mg antioxidant.

Assay procedures and analyses

Standardized methods, as per Commission Regulation (EC) no. 152 (2009), were used to determine the gross chemical composition of the feed ingredients and of the compound feeds. Crude protein was determined by the Kjeldal method, on the basis of the nitrogen content. The crude fat was determined by continuous extraction in organic solvents followed by fat measurement with Soxhlet, after solvent removal. The crude fibre was determined with a classical semiautomatic Fibertec-Tecator method. The metabolisable energy (ME) was calculated using the regression equations developed by the „Oskar Kellner" Institute of Animal Nutrition: ME = 5.01 × DP + 8.93 EE + 3.44 CF + 4.08 DNFE.

At the end of the experiment blood samples were collected by jugular venepuncture in order to assay cholesterol, lipase and triglycerides concentration in the serum. The serum total cholesterol and lipase concentration were determinate by colorimetric enzymatic method and the triglycerides level were assessed by Analyser BS – 130. The samples were transported in vacutainer and kept at -80 ^{0}C up to their analyses.

Statistical analyses and calculation

The experimental data were submitted to variance analysis using by SPSS - general linear model (Statistics version 20, 2011) at 10%, 5%, 1% and 0.001% significance level. The response to the dietary treatment was variable dependent, and the diet and/or sampling day were fixed factors.

RESULTS AND DISCUSSION

Performances

The sorghum has a higher feeding value as results of low antinutritional factors in the new variety, especially white variety.

Figure 1 shows the influence of the dietary addition of sorghum grain *Albanus* on performances. The average initial weight was similar between groups (6.95 ± 0.97 kg). The final weight was not significantly influence by dietary addition of the sorghum (11.00 ± 0.86 kg corn diet vs 11.89 ± 1.4 kg sorghum diet). The ADG was 7.49% higher in sorghum group (P = 0.17). The ADFI was slightly higher in group fed with sorghum diet (0.381 kg/d) compared to corn fed group (0.296 kg/d), maybe due to lower energy content of sorghum grains. Feed conversion ratio (feed:gain) was similar (1.58 g feed: g gain in corn fed group compared to 1.43 g feed: g gain in sorghum fed group). The previous data have shown a high variation in piglet's response regarding ADG, ADFI (Richert et al., 1992, Healy et al., 1994, Fialho et al., 2004, Sotak et al., 2014, Jordan et al., 2015, Tokach, Goodband and De Rochey, 2016).

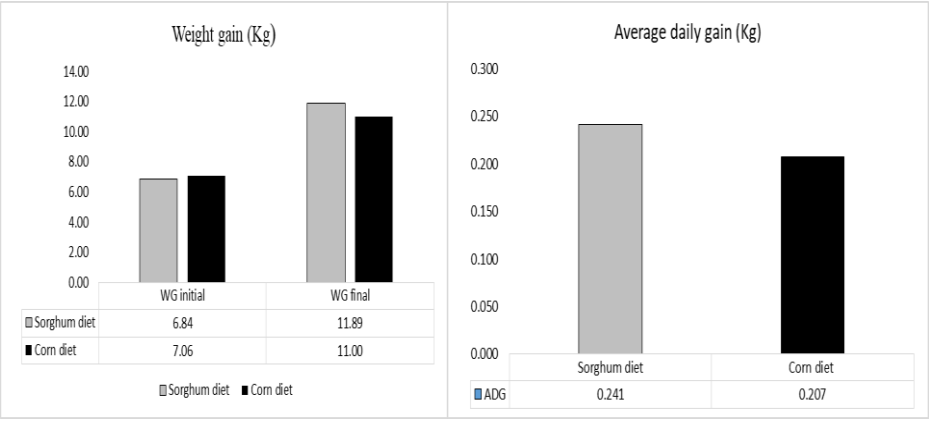

Figure 1. Growth performances

Biochemical parameters

Incomplete development of enzymatic system of weaning piglets associated with stress generated of vary factors (the separation of their mother, changes in the diet and the environment etc.) lead to an increase susceptibility of the piglets to digestive problems (Liu et al., 2017). A high content in blood cholesterol and triglycerides is associated with an increased risk of disorder in the animal body and a sign of metabolic syndrome. The piglets' organism uses the triglycerides as energy source with consequences on health conditions. Lipase has different function in domestic animal playing an important role in the storage and mobilization of exogenous fat (Chen et al., 2014). An insufficient concentration of lipase enzyme has negative influence on fat metabolism.

Figure 2 shows the serum cholesterol, lipase and triglycerides level.

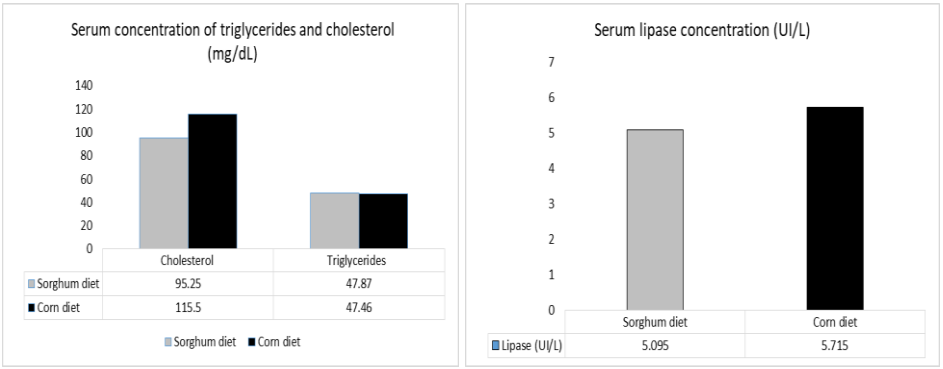

Figure 2. Serum concentration of certain biochemical parameters (cholesterol, lipase, triglycerides).

In our study the sorghum added in the diet decreased the serum cholesterol content by 21.25% (P =0.03), due probable to phytochemical compound of the sorghum grains relative higher compared with fruits, vegetables, and other cereal grains (Weihrauch and Gardner, 1978, Carr et al., 2005). The lipase enzyme can influence appetite and influence beneficial cholesterol and triglyceride concentration. Although, generally lipase concentration is correlated negatively with the cholesterol and triglycerides level, in our study the dietary incorporation of 20% sorghum *Albanus* decreased by 12.18% the serum level of lipase (P = 0.16) and cholesterol level as well. May be the sorghum bioactive compound compensated the lower level of lipase in sorghum diet as well as the lipase level was insignificantly decreased and the level was sufficient for covering the requirements. Contrary, the triglycerides concentration was 0.87% higher in sorghum diet and were negatively correlated with lipase enzyme. The level of the triglycerides increased 1.09 times on serum sorghum fed groups compared to corn groups. Except cholesterol concentration the other serum parameter did not differ significantly between groups.

CONCLUSIONS

Sorghum became an important alternative vegetable source for swine feeding due to its excellent nutritive value. Dietary addition of sorghum grain improve the growth parameters although, sorghum digestibility is lower. Due probably to bioactive compound as photochemical constituents, the cholesterol level decreased significantly by dietary sorghum *Albanus* addition. Without a significant effect on triglycerides and lipase concentration sorghum diet decreased lipase content while the triglycerides level was slight increased.

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