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REGULAR ARTICLE

STUDY OF DIGESTAROM® 1324 EFFECT ON SELECTED PARAMETERS OF MAIZE DDGS QUALITY IN PIG NUTRITION

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ABSTRACT

A digestibility experiment using six ileally cannulated growing gilts (initial body weight 39.9 kg) was carried out to study the effect of DIGESTAROM® 1324 - phytogenic feed additive supplemented to the diet, on total tract and ileal digestibility of nutrients. The main components of the diets (56.6 %) were maize-based distillers dried grains with solubles (DDGS) - produced from the fuel ethanol industry- supplemented with starch (20 %), sugar (20 %), minerals and vitamins (2.4 %). Cellite (1 %) was added to the diets as a source of acid insoluble ash. The tested preparation DIGESTAROM® 1324 was added to the experimental diet D in amount of 0.03 %. Diet C was the control diet. The supplementation of DIGESTAROM® 1324 to the diet insignificantly improved total tract and ileal digestibility of dry matter, organic matter, nitrogen, ash and phosphorus. The increase was within the span 0.6 – 2.2 %. Values of apparent and true ileal digestibility of amino acids were higher in the experimental diet D compared with the control diet C for all amino acids except for histidine. The improvement varied from 0.2 % (leucine) up to 15.2 % (proline). The tested preparation DIGESTAROM 1324® influenced positively but no significantly all parameters studied in the experiment.

Keywords: DDGS, DIGESTAROM® 1324, nutrient digestibility, pig

INTRODUCTION

Distillers dried grains with solubles (DDGS) are produced from the fuel ethanol industry and are available for inclusion in diets fed to pigs in all phases of production without negatively affecting pig performance **(Whitney *et al*., 2004; DeDecker *et al*., 2005; Cook *et al*., 2005; Feoli *et al*., 2007, Goihl, 2009, Stein and Shurson, 2009)**. In general, DDGS has higher concentrations of nutrients such as protein, fat, vitamins, minerals, and fibre than its parent crop. These nutrients are concentrated due to the removal of most of the cereal starch as ethanol and carbon dioxide during the fermentation process (**Kim *et al*., 2009**) There is still much to learn about the potential use of this material in animal feeds and in particular about its nutritional value (**Fastinger and Mahan, 2006**).

The aim of the study was to determine selected chemical parameters, total tract digestibility and ileal digestibility of nutrients in maize DDGS and to assess the effect of DIGESTAROM® 1324, supplemented to a maize-based DDGS diets, on total tract and ileal digestibility of nutrients.

MATERIAL AND METHODS

Diets and feeding

A two semipurified diets, marked C and D, were included in the experiment (Tab 1).

Cellite was added to the diets as an indigestible marker. The diets were formulated on the basis of proximate analyses of DDGS. The experimental diet D was supplemented with tested preparation DIGESTAROM® 1324 in an amount of 0.03 %. Phytogenic feed additive DIGESTAROM ® 1324 belongs to a group of digestibility enhancers and is used in feeding mixtures in the form of powder. Diet C was the control diet.

Course of experiment

Six gilts (average body weight of 39.9 kg ± 1.9) fitted with T-cannula in terminal ileum were used in the experiment.

Experimental schedule: 1. day – selection and housing the pigs in balance cages
5.-6. day – surgically fitting the pigs with T-cannulas
7. - 20. day – recovery period

21. - 35. day – main experiment - 2 experimental periods (2x7 days)

Table 1 Component and chemical composition of diets (g.kg^{-1} dry matter)

Component	Experimental diet D	Control diet C
Maize DDGS	565.50	565.50
Sugar	200.00	200.00
Starch	200.00	200.00
Limestone	18.00	18.00
Salt	3.50	3.50
Premix	3.00	3.00
Cellite	10.00	10.00
DIGESTAROM® 1324	0.30	---
Crude protein	164.61	164.92
Nitrogen	26.34	26.39
Crude fibre	39.75	40.00
Ash	57.23	56.89
Phosphorus	5.42	5.57

The animals were fed two times a day at 6:00 a 16:00 hour, with a mash diet (water : feed ratio 2:1) at a minimal rate of 85 g.kg$^{-0.75}$. Feed consumption was recorded daily. Water was available *ad libitum*. During the 5- 6 th day of each experimental period, urine samples were collected via bladder catheters draining into vessels containing 5% H_2SO_4. Feces were collected by grab sampling at day 6 and 7. At the 7-th day, ileal digesta was collected for 24 hours. The samples were then frozen at - 20°C and stored for further analyses.

Chemical analysis

Analyses of diets and ileal digesta for dry matter, organic matter, nitrogen, phosphorus and ash were performed in accordance with standard methods of **AOAC (1990)**. Acid insoluble ash in HCl was determined gravimetrically after the acid hydrolyses 3M HCl, and following a firing at 550 ºC. Amino acid content was determined using an automatic amino acid analyzer AAA 400 (fy Ingos Praha).

Calculations and statistical analyses

On the basis of obtained results and according to the corresponding patterns, we calculated the apparent ileal digestibility of dry matter, organic matter, nitrogen, phosphorus, ash and amino acids and true ileal amino acids digestibility of tested diets. In addition the values of total tract digestibility of dry matter, organic matter, nitrogen, phosphorus and ash were calculated.

Coefficients of apparent ileal digestibility of amino acids were calculated according this equation:

$$\text{Apparent ileal digestibility (\%)} = 100 \times [1-(N_i \times C_d)/(N_d \times C_i)]$$

Where N_d a C_d are the content of observed nutrition, acid-insoluble ash in HCl in diet ($g.kg^{-1}$ dry matter) and N_i a C_i are the content of observed nutrition, acid-insoluble ash in HCl in ileal digesta ($g.kg^{-1}$ dry matter).

Coefficients of true ileal digestibility of amino acids were calculated according to the equation:

$$\text{True ileal digestibility (\%)} = \text{apparent ID} + 100*\text{IFL/AKd}$$

Where ID is ileal digestibility, IFL are endogenous losses of amino acids ($g.kg^{-1}$ dry matter) and AKd content of amino acids in ilea digesta ($g.kg^{-1}$ dry matter).

Nitrogen retention, based on the nitrogen balance, was calculated according to the following equation:

$$N_{Ret} = N_I - N_{urine} - N_{fec}$$

Where N_{Ret} is retention of N; N_I is the amount of N intake, N_{urine} is the amount of excreted nitrogen in urine, N_{fec} is the amount of nitrogen excreted with feces.

The experimental dates were statistically evaluated according to the STATGRAPHIC Plus. Significant differences were tested by the T-test.

RESULTS AND DISCUSSION

After the recovery from surgery, the pigs remained in good health throughout the experiment. We observed a slight increase in total digestibility of dry matter, organic matter, nitrogen, phosphorus and ash and amino acids in animals fed the diet with DIGESTAROM 1324® additive; the span for individual nutrients was from 0.6 – 2.1 % (Tab 2). Total digestibility of N rose by 1.1 %, compared with the diet without DIGESTAROM 1324®.

Table 2 Average values of total digestibility of nutrients in DDGS without (C) and with DIGESTAROM 1324® (D) additive

Sample	Total tract digestibility (%)				
	Dry matter	Organic matter	Nitrogen	Ash	Phosphorus
Control diet C	82.4	84.9	80.7	41.0	49.1
Experimental diet D	83.1	85.5	81.8	43.1	51.7
P value	0.20	0.32	0.37	0.14	0.59

Apparent ileal digestibility of all studied nutrients was insignificantly higher in the experimental diet (Tab 3). Animals fed the diet with DIGESTAROM 1324® additive excreted less nitrogen in feces and urine compared with animals fed the control diets. The content of nitrogen in feces decreased insignificantly by 0.6 g/day and in urine by 0.8 g/day. Nitrogen retention from the received nitrogen was higher by 1.8 % in animals fed the experimental diet. However, the detected differences were not statistically relevant.

Table 3 Average apparent ileal digestibility of nutrients in DDGS without (C) and with DIGESTAROM 1324® (D) additive

Sample	Apparent ileal digestibility (%)				
	Dry matter	Organic matter	Nitrogen	Ash	Phosphorus
Control diet C	67.3	70.3	69.1	16.8	41.9
Experimental diet D	68.3	71.3	70.8	19.0	40.2
P value	0.16	0.21	0.22	0.24	0.76

Values of apparent and true ileal digestibility of amino acids were higher in the experimental diet compared with the control diet for all amino acids except for histidine (Tab 4). The improvement varied from 0.2 % (leucine) up to 15.2 % (proline). Digestibility of lysine was higher by 3.4 % and digestibility of sulphuric amino acids rose by 1.6 % for cystine and by 0.7 % for methionine.

The total tract digestibility, apparent and true ileal digestibility of nitrogen was comparable with data as were published by **Pahm *et al.* (2006), Pahm *et al.* (2008), Pedersen *et al.* (2007), Urriola *et al.* (2009).**

Our results of apparent and true ileal digestibility of lysine are in ranges as reported **Ren *at al.* (2011)** - lysine (from 41.8 to 65.8% and 53.8 to 73.9% respectively) and threonine

(from 54.3 to 73.8% and 65.2 to 79.5% respectively). In the literature there is no information about the effect of DIGESTAROM 1324® in DDGS diets.

Tab 4 Apparent and true ileal digestibility of amino acids in DDGS without (C) and with DIGESTAROM 1324® (D) additive (%)

Amino acid	Apparent ileal digestibility		P value	True ileal digestibility		P value
	C	D		C	D	
Aspartic acid	68.9	70.1	0.33	75.7	77.0	0.27
Threonine	66.1	68.0	0.11	73.9	75.9	0.10
Serine	76.3	77.1	0.49	82.7	83.4	0.50
Glutamic acid	82.9	83.9	0.06	86.6	87.6	0.05
Proline	17.9	33.2	0.49	30.3	45.8	0.48
Glycine	41.0	48.8	0.17	54.2	62.2	0.16
Alanine	80.6	81.9	0.21	85.0	86.4	0.20
Valine	75.4	76.1	0.28	81.1	82.1	0.13
Isoleucine	77.2	77.3	0.95	82.8	83.2	0.46
Leucine	86.3	86.5	0.51	89.1	89.4	0.44
Tyrosine	82.5	83.0	0.64	89.8	90.1	0.74
Phenylalanine	74.8	77.8	0.33	79.1	82.1	0.33
Histidine	71.9	71.3	0.80	76.1	75.6	0.81
Lysine	55.9	59.3	0.12	65.2	68.9	0.10
Arginine	79.2	79.8	0.74	84.2	85.2	0.58
Cystine	76.9	78.5	0.11	82.6	84.2	0.12
Methionine	86.5	87.2	0.21	90.5	91.2	0.26

CONCLUSION

The tested preparation DIGESTAROM 1324® influenced positively all parameters studied in the experiment. However, the effect was not statistically significant.

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