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INFLUENCE OF DIETARY BETAINE SUPPLEMENTATION ON THE GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS IN MALE AND FEMALE GROWING-FINISHING PIGS

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Abstract

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A study with 20 pigs (10 males and 10 females) of the genetic population Danube White x Landrace was carried out at the Agricultural Institute – Shumen. Both male and female pigs were divided in control and experimental groups. The animals from the experimental groups received a diet supplemented with betaine in amount 0.1 %. The duration of the experimental period was 32 days. After slaughter the measurements of the carcass were made as follows: hot carcass weight, back fat thickness at the last rib and between 3rd and 4th rib, thickness of *m .Gluteus medius*, back fat thickness over *m. Gluteus medius*. After 24 h storage at 4°C the big and the small length of the carcass, the size and the length of the leg, the thickness of *m. Longissimus dorsi* at the last rib as well as its area were measured. The lean meat percentage was calculated using a regression equation.

The growth performance of the animals from both sexes was not changed after betaine supplementation. Dietary betaine decreased the leg size in males ($p<0.05$) and leg length in females ($p<0.01$). After betaine supplementation a tendency was observed for decreased back fat thickness in the males compared to the females which corresponds to the slightly higher lean meat percentage in the former.

The results of the present study suggest that the effect of betaine on the growth performance and carcass traits in the pigs, raised in Bulgaria could be fully clarified after further investigations with different diets and betaine concentrations as well as different durations.

Key words: pigs, betaine, carcass composition

Introduction

Research attention has focused towards investigating the control of fat and lean deposition in pigs in order to meet the requirements of the consumer for a healthier diet. Feed additives have been studied for their abilities to promote feed efficiency and improve carcass composition especially through decreasing fat deposition.

Betaine, an aminoacid derivative is a product of

choline degradation and widely spread in nature. The availability of three chemically active methyl groups in its molecule allows it to function as a methyl donor in the organisms via transmethylation, thus partially reducing the requirements for other methyl donors such as methionine and choline and participating in the protein and lipid metabolism (Saunderson and Mackinlay, 1990; Kidd et al., 1997, Simon et al., 1999; Huang et al., 2006).

The use of betaine in the swine diets has increased recently though the results for the growth and carcass performance have been inconsistent. The initial studies (Cadogan et al., 1993) reported marked decrease in the back fat thickness of pigs and no effect on the other growth parameters. Numerous other studies have reported that betaine could decrease carcass fat deposition and increase lean meat in pigs and potentially affect feed intake (Casarin et al., 1997; Matthews et al., 2001; Lawrence et al., 2002). Other studies (Matthews et al, 1998; Overland et al., 1999) reported either minimal or no effect on growth performance and body fat.

The objective of this experiment is to study the effect of betaine on the growth performance and carcass characteristics in pigs (females and male castrates) from Danube White x Landrace.

Materials and Methods

The experiment was carried out at the Agricultural Institute –Shumen with 20 pigs (10 males and 10 females) from Danube White x Landrace genetic population, evened by sex, age and live weight. The pigs were housed in individual pens. The animals were fed twice a day with concentrate with main ingredients and chemical composition presented in Tables 1 and 2 respectively. Water was *ad libitum*. The experimental period lasted 32 days in which the pigs from the experimental group were fed diet containing 0.1 % betaine (Betafin S1, Danisco A/S, Denmark).

The pigs from the control groups had initial average live weight 78.60 -81.40 kg and those from the experimental 77.00- 82.20 kg, respectively for the males and females.

Hot carcass weight was measured up to 1 h *post mortem*. Back fat thickness at the last rib, between 3rd and 4th rib, thickness of *m.Gluteus medius* and back fat thickness over *m. Gluteus medius* were measured up to 45 min *post mortem*.

After 24 h storage at 4°C big and small length of the carcass, size and length of the leg, thickness of *m. Longissimus dorsi* at the last rib, as well as area of *m. Longissimus dorsi* were measured.

To establish lean meat percentage was used a regression equation (Regulation №21/14.05.2004)

$Y = 48.785-0.386x_1-0.215x_2+0.226x_3$

Y – lean meat %

x_1- back fat thickness (mm) measured at the last rib at 8 cm laterally from the carcass midline

x_2- backfat thickness (mm) measured between 3-d and 4-th rib at 6 cm laterally from the carcass midline

x_3- thickness of the muscle, measured at the same time and location as X_2.

The results are presented as mean ($\bar{x}$) and standard deviation (Sd) and the statistical evaluation was made using *t*-criterion of Student, where $p<0.05$-*, $p<0.001$-**, $p<0.001$-***.

Results and Discussion

The initial live weight averaged 77.8 kg and 81.1 kg for the male and female pigs respectively (Table 3). Betaine supplementation had no effect on average

Table 1
Ingredients of the basal diet for pigs

Ingredients	%
Corn	30
Wheat	37
Wheat bran	19
Sunflower meal	12
Vitamin-mineral premix	0.5
Lime	1
Lysine	0.2
Salt	0.3

Table 2
Chemical composition of the diet

The concentrate contains	
Crude protein, g	129.4
Crude fibers,g	58.6
Fats,g	24.7
Ca, g	5.6
P,g	5.2
Methionine +cystein,g	4.7
Tryptophane,g	1.6
Treonine, g	4.2
Lysine,g	6
Metabolizable energy,kcal/kg	2873

daily gain and final live weight neither in the males nor in the females, which is in agreement with the results of Matthews et al. (2001) and Lawrence et al. (2002). In contrast, Huang et al. (2006) reported increased average daily gain in pigs fed 0.125 % betaine. The lack to observe any significant changes in growth performance of the pigs in this experiment might be due to the increased protein and energy level of the diet as well as the genetic profile of the pigs.

No changes due to dietary betaine supplementation were observed in carcass hot weight and dressing percentage in the males and females as well. Similarly, Huang et al. (2006) did not observe changes in dressing percentage due to the betaine supplementation or sex of the animals. By contrast, Lawrence et al. (2002) reported higher dressing percentage in gilts compared to barrows.

Lean meat percentage increased by approximately 1 % in the males from the experimental group compared to the control. The value of this trait in the carcass related to the smaller measurements of the back fat thickness (Table 4) in the carcasses of the male experimental animals in comparison to the control ones. On the other hand it corresponded with the decreased thickness of *m. Longissimus dorsi* in the carcasses of pigs received betaine. Lower lean meat percentage in the female animals from the experimental group, compared to control, was due to the decreased thickness of *m. Longissimus dorsi* and the slightly higher back fat thickness in the carcass. In his research Lawrence et al. (2002) observed higher lean percentage in female pigs, compared to males.

Big and the small carcass length (Table 4) were not significantly affected by betaine neither in males nor in females, which is in contrast with Mathews et al. (1998) and Matthews et al. (2001).

Significant effect of the tested factor (betain) was detected on the traits size of leg in males and length of leg in females. A tendency for lower back fat thickness in experimental male castrates compared to control ones was outlined. Females had lower thickness of *m. Longissimus dorsi* at the two locations than males in both groups. Between the experimental groups the differences were respectively 19.53 % at the last rib and 8.78 % at 3rd/4th rib.

In male pig's thickness of *m. Gluteus medius* was not affected while in females a tendency for increase was observed with betain supplementation.

The potential of betaine as a carcass modifier could be explained by its participation in the protein and lipid metabolism. Betaine increases the levels of the methionine and cysteine in the organism for a protein synthesis (McDevitt, 2000). The improved utilization of the amino acids from the diet for protein synthesis could decrease the availability of amino acids for desamination and subsequent fatty acid synthesis (Wallis, 1999).

On the other hand according Feng et al. (1996) the decreased fat deposition in pigs after betaine supplementation could be due to either increased lipolysis or decreased lipogenesis. The latter is confirmed by Huang et al. (2008) who reported decreased activity in the lipogenic enzymes in betaine supplemented pigs.

Betaine has been reported to decrease back fat thickness (Cadogan et al., 1993; Casarin et al., 1997). However, other reports (Webel et al., 1994; Overland et al., 1999) have shown that 0.125 % or 1.0 % of betaine did not influence carcass traits which is in agreement with our results. Haydon et al. (1995) reported that the thickness of the back fat and the loin muscle area might be differentially affected by 0.1 %

Table 3
Growth performance of the pigs in response to dietary betaine supplementation

Traits	Groups							
	Male				Female			
	Control		Experimental		Control		Experimental	
	$\bar{x}$	Sd	$\bar{x}$	Sd	$\bar{x}$	Sd	$\bar{x}$	Sd
Initial live weight, kg	78.6	4.77	77	4.74	81.4	2.3	82.2	1.79
Final live weight, kg	97.8	3.83	96.4	3.51	99.4	1.82	99.4	2.79
Average daily gain, kg	746	152	693	123	643	121	614	93
1/2 hot carcass, kg	35.5	1.51	34.79	1.21	36.59	0.87	37.01	1.44
Dressing percentage, %	78.74	1.09	78.9	1.29	76.34	4.48	80.5	2.39
Lean meat, %	39.5	6.06	40.45	3.48	43.32	1.76	41.24	2.2

Table 4
Carcass traits of the pigs in response to dietary betaine supplementation

Traits	Groups							
	Male				Female			
	Control		Experimental		Control		Experimental	
	$\bar{x}$	Sd	$\bar{x}$	Sd	$\bar{x}$	Sd	$\bar{x}$	Sd
Big slaughter length, cm	91.3	3.6	90.8	2.28	91.5	1.66	90.6	3.36
Small slaughter length, cm	77.6	2.61	77.6	1.95	78.4	1.82	79.2	1.1
Leg size, cm	66.80*	0.57	65.2	0.67	67	1.22	67.2	0.76
Leg length, cm	42.7	0.97	41.6	1.14	42.80**	1.3	40.5	0.5
Thickness at:								
-Back fat at the last rib, mm	28.60	5.59	23.60	3.36	24.20	3.83	25.00	3.39
-Back fat between 3-d and 4-th rib, mm	32.20	7.79	29.60	5.41	28.20	2.59	29.40	4.28
-at the last rib 8 cm laterally , mm	28.40	7.77	26.60	5.81	24.40	3.65	26.20	4.87
-between 3-d and 4-th rib 6 cm laterally, mm	30.40	5.68	26.80	4.97	23.20	3.42	28.80	3.42
-*m. LD* at the last rib, mm	42.16	5.10	38.88	3.95	46.80	1.65	48.32	6.82
-*m. LD* between 3-d and 4-th rib, mm	39.46	9.80	34.06	3.15	39.84	2.49	38.78	4.93
- at *m. Gluteus medius* , mm	18.40	5.55	18.40	6.35	19.00	1.00	20.20	1.92
-at fat over *m. Gluteus medius* , mm	31.80	4.38	31.00	4.06	28.60	6.15	32.80	4.66
Area of *m. LD* , cm	31.77	5.08	32.15	5.79	37.03	2.50	34.42	2.02

betaine depending on the lysine: calorie ratio or energy level of the diet, which reveals that the effect of betaine depends on the dose and the energy of the diet.

According Lawrence at al. (2002) the change in the carcass traits due to dietary betaine supplementation depends on the duration of the experimental period and the adipose tissue deposition in females may

be less altered, compared to males because of their low potential for fat deposition. Our results suggest that there might be a difference in the fat deposition between males and gilts and the dietary supplementation of betaine could be more effective in altering carcass traits in males.

Conclusion

In the present study dietary betaine supplementations did not change the growth performance in the pigs from both sexes. The only carcass traits that were influenced by betaine were leg size in males and leg length in females. After betaine supplementation a tendency was observed for decreased back fat thickness in the males compared to the females.

In order to fully clarify the effects of betaine on the growth performance and carcass traits in pigs raised in Bulgaria further investigations are needed with different diets and betaine concentrations as well as different durations.

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