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Original Paper

The effect of protein metabolism on weanlings blood parameters level

Lubor Bindas,* Iveta Maskaľová, Lukáš Bujňák

University of Veterinary Medicine and Pharmacy in Košice, Slovak Republic

This study was conducted to determine the effects of low-protein diets supplemented with crystalline amino acids (AA) on biochemical parameters and performance in 10 crossbred piglets weaned at 28 days of age (2 groups of 5 each, 8.8 ±0.6 kg and 8.6 ±0.7 kg live weight). The treatments were a control diet containing 210.8 g kg^{-1} CP (crude protein) and low protein diet containing 186.4 g kg^{-1} supplemented with crystalline AA (lysine, threonine, methionine) to achieve an ideal AA pattern. Blood from all piglets was taken for determining biochemical parameters 5 weeks after weaning. The decrease in the diet CP content was manifested signification (P <0.01) decrease concentrations of blood urea (average concentrations 2.61 mmol l^{-1} and 4.21 mmol l^{-1}), which means the increase of biological value in the feed mixture.

Keywords: amino acids, biochemical parameters, protein, pig, biological value

1. Introduction

Protein source is very important factor for nursery pigs growth, because poor amino acid and protein nutrition have a profound effect on physiology health status and growth factor of pigs. Diets with high crude protein (CP) content are commonly used for early-weaned pigs. This kind of diet can improve growth performance of piglets, but is always associated with incidence diarrhoea (Qiao, 2003). Proteins are composed of amino acids, and it is actually the amino acids that are the essential nutrients. The primary factors affecting bioavailability are the efficiencies of protein digestion and amino acid absorption and the efficiency of using amino acids at the tissue level after absorption. One cause of reduced digestibility of high protein level diets for weaning pigs is their high buffering capacity (Bindas 2008). Reducing dietary crude protein level balanced with amino acids (AA) has become an alternative approach to reduce the incidence of diarrhoea and maintain performance in weaned pigs (Yue and Qiao, 2008). Commonly, only lysine, methionine, threonine, or tryptophan, are available in commercial and economic quantities and can be added to piglet diets in order to maintain the ideal protein profile as dietary CP is decreased. The objectives of the present experiments were to determine the effects of reducing the dietary CP content from 21.1–18.6% on serum biochemical parameters

2. Material and methods

2.1 Animal and diets

The experiment was conducted with 10 crossbred piglets (Slovakian White × Landrace), with an initial average body weight (BW) 8.8 ±0.6 and 8.6±0.7 kg and weaning at 28 days of age. At weaning, piglets were divided into two groups (5 pcs per each).The treatments contained equal number of females (3) and castrated males (2). The experimental diets were formulated with 2 levels of CP. Complete feed mixture for piglets was fed in the control group with CP 210.8 g kg^{-1}, in the experimental group with reduced concentration of CP 186.4 g kg^{-1}. The low CP diet was supplemented with lysine (Lys), methionine (Met), threonine (Thr). The experiment was carried out in the barns of Institute of Animal Nutrition and Dietetics at the University of Veterinary Medicine in Košice in compliance with the EU regulations concerning the protection of experimental animals.

2.3 Analysis

Diets were analyzed for dry mater (DM), crude protein (CP), crude fibre (CF),neutral detergent fibre (NDF), ether extract (EE), ash by the AOAC (2001). Blood collection for determination of biochemical parameters was performed 4 times at weekly intervals in the control and experimental group, 4–5 hours after feeding from *sinus ophthalmic*. Biochemical parameters total proteins, albumin, urea, glucose, total lipids, cholesterol, aspartate aminotransferase (AST), alkaline phosphatase (ALP) blood serum levels were determined by biochemical analyser "Ellipse".

2.4 Statistical analysis

To calculate the basic statistic characteristics, differences between the groups pigs were evaluated by paired *t*-test in Excel.

***Correspondence:** Lubor Bindas, University of Veterinary Medicine and Pharmacy in Košice, Department of Nutrition, Dietetics and Fodders, Košice, Slovak Republic

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3. Results and discussion

This experiment was performed to investigate the effects of feeding low crude protein diets to piglets on biochemical parameters in blood serum. The experimental diet with reduced concentration CP (186.4 g kg^{-1} resp.210.8 g kg^{-1}) were supplemented with Lys, Met, Thr, of meet the required levels of these amino acids NRC (1998). Protein source is very important factor for nursery pigs growth, because poor amino acid and protein nutrition have a profound effect on physiology health status and growth factor of pigs. Diets with high crude protein (CP) content are commonly used for early-weaned pigs. This kind of diet can improve growth performance of piglets, but is always associated with incidence diarrhoea (Qiao, 2003). Proteins are composed of amino acids, and it is actually the amino acids that are the essential nutrients. The primary factors affecting bioavailability are the efficiencies of protein digestion and amino acid absorption and the efficiency of using amino acids at the tissue level after absorption. One cause of reduced digestibility of high protein level diets for weaning pigs is their high buffering capacity. Indeed, feeding weaned pigs a lower level of crude protein caused lower ammonia concentrations in the small intestine (Bikker et al., 2006) and decreased plasma urea nitrogen, ammonia nitrogen and volatile fatty acids in the ileal digesta (Nyachoti et al., 2006). These data are indicative of reduced dietary crude protein level balanced with amino acids (AA) has become an alternative approach to reduce the incidence of diarrhoea and maintain performance in weaned pigs (Piva et al., 2006). Reducing the dietary crude protein level of the diet and supplementing it with limiting crystalline AA can reduce nitrogen excretion, which may prevent surface and ground water contamination (Lynch et al., 2007, Bindas and Maskaľová, 2011). The increasing availability of crystalline amino acids allows reduction of the crude protein level in piglet diets in association with adequate AA supplementation, which maintains sufficient essential AA supply with little or no decrease in growth performance (Figueroa et al., 2002). The nutrient content of diets used in experimental periods is shown in Table 1.

Table 1 Chemical composition of experimental diets

Parameters in g kg^{-1}	Control diet		Experimental diet	
Dry mater	903.70	1000	902.70	1000
CP	210.80	233.26	186.40	206.49
NDF-CP	11.07	12.25	10.40	11.52
EE	13.30	14.72	12.90	14.29
CF	38.60	42.71	39.50	43.76
NDF	161.00	178.16	169.9	188.21
ADF	49.80	55.11	47.50	52.62
Ash	67.80	75.02	65.40	72.45
NFE	573.20	634.29	598.50	633.01
Lys	12.60	13.94	13.00	14.40
Thr	7.90	8.73	8.00	8.86
Met + cys	6.70	7.41	6.90	7.64

CP – crude protein, NDF – CP – neutral – detergent fibre – crude protein, EE – etheric extract, CF – crude fibre, NDF – neutral-detergent fibre, ADF – acid-detergent fibre, NFE – non-fibrous carbohydrates, Lys – lysine, Thr – threonine, Met + cys – methionine + cysteine

No significant differences between groups in serum total protein were observed throughout the trial and their levels (49.61–55.86 g l^{-1}) were within the reference range Kraft et al. (2001). Similar applied to the level of albumin (29.07–34.82 g l^{-1}). Urea as an important indicator of protein nutrition showed marked changes. During whole experiment, serum urea nitrogen was significant (P <0.01) differences lower in pigs fed with low CP diet supplemented with lysine, methionine, threonine, compared to which consumed a higher CP diet. Urea excreted in urine is the main nitrogenous end-product from amino acids catabolism in pigs and plasma or serum urea concentrations may be indicative of excreted N in urine (Roth and Raczek, 2003). Serum or plasma urea nitrogen can be used in various animal species to quantity N utilization and excretion rates. Lower blood urea nitrogen indicated higher availability of dietary nitrogen.

The biochemical parameters in blood serum in weaning pigs oscillated within relatively wide ranges of physiological values for pigs, presented by the authors Doubek et al. (2010). The mean values of biochemical parameters as total protein, albumin, glucose, total lipid, cholesterol, activity of liver enzymes aspartate aminotransferase, alkaline phosphatase did not differ significantly within the groups. In conclusion, our study showed that decrease in the diet pigs CP content was manifested significant (P <0.01) differences decrease concentrations of blood urea which means the increase of biological value in the feed mixture. The metabolic variables in blood serum analysed of the study in Table 2.

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Table 2 Effect of dietary CP on biochemical parameters of piglets

Parameters	Control diet (21.1% CP)				Experimental diet (18.6% CP)			
Week	**1.**	**2.**	**3.**	**4.**	**1.**	**2.**	**3.**	**4.**
Total protein in g l^{-1}	51.9±2.85	52.94±2.96	55.86±3.40	54.70±3.27	50.74±1.89	53.74±2.69	53.30±3.82	49.61±1.33
Urea in mmol l^{-1}	2.92^{a}±0.11	4.52^{a}±0.48	4.39^{a}±0.32	4.99^{a}±0.51	1.69^{b}±0.35	3.06^{b}±0.23	2.63^{b}±0.28	3.06^{b}±0.40
Albumin in g l^{-1}	30.28±1.09	33.44±1.79	34.82±1.03	32.69±2.00	29.07±2.33	33.15±1.30	32.56±2.41	30.62±2.04
Glucose in mmol l^{-1}	5.30±0.51	4.92±0.23	5.99±0.47	3.77±0.79	5.22±1.86	5.03±0.67	6.01±2.42	3.81±0.32
Total lipid in g l^{-1}	1.68±0.08	1.62±0.49	1.84±0.25	1.83±0.20	1.76±0.87	1.59±0.39	1.80±0.49	1.64±0.21
Cholesterol in mmol l^{-1}	1.85±0.35	2.28±0.38	1.93±0.22	2.18±0.21	1.75±0.24	2.06±0.25	1.970.12	1.99±0.04
AST in ukat l^{-1}	0.26±0,02	0.29±0.08	0.36±0.04	0.24±0.02	0.22±0.05	0.37±0.03	0.40±0.03	0.24±0.01
ALP ukat l^{-1}	5.49±0.65	5.25±0.59	4.66±1.47	5.17±0.61	6.06±0.03	5.86±0.28	5.68±0.96	5.70±0.09

ab Significant differences (P <0.01) AST – aspartate aminotransferase, ALP – alkaline phosphatase

from amino acids catabolism in pigs and plasma or serum urea concentrations may be indicative of excreted N in urine (Roth and Raczek, 2003). Serum or plasma urea nitrogen can be used in various animal species to quantity N utilization and excretion rates. Lower blood urea nitrogen indicated higher availability of dietary nitrogen

The biochemical parameters in blood serum in weaning pigs oscillated within relatively wide ranges of physiological values for pigs, presented by the authors Doubek et al. (2010), Kraft and Durr (2001). The mean values of biochemical parameters as glucose, total lipid, cholesterol, activity of liver enzymes aspartate aminotransferase, alkaline phosphatase did not differ significantly within the groups.

4. Conclusions

The present study demonstrated that feeding low CP (186.4–210.8 g kg^{-1}) diet formulated to a recommended ideal amino acids pattern with Lys, Thr and Met to pigs for 7, 14, 21, 28 days after weaning reduces significantly (P <0.01) concentrations of blood urea which means the increase of biological value in the feed mixture. The mean values of biochemical parameters as glucose, total lipid, cholesterol, activity of liver enzymes aspartate aminotrasferase, alkaline phosphatase did not differ significantly within the groups.

5. Acknowledgement

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