Effect of Apple Pectin Supplementation on Productivity and Some Blood Parameters in Fattening Pigs

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Abstract

A scientific and economic experiment was conducted at the Agricultural Institute – Shumen, with fattening pigs of the Danube White breed. The duration of the experiment was 36 days. The animals were divided into two groups (control and experimental) of 13 animals, fed and bred in individual pens. Apple pectin was added to the feed of the pigs in the experimental group in the amount of 7 g per capita daily. The experiment started at an average live weight of 58.317 kg–58.846 kg and ended at 101.000 kg–100.831 kg, respectively, for the pigs of the control and experimental groups.

The aim of the experiment was to determine the effect of apple pectin supplementation on productivity, health status and some blood parameters in fattening pigs.

Supplementation of 7 g of apple pectin per capita daily in compound feeds of fattening pigs had no positive effect on pig growth rate and feed utilization. Pigs receiving a supplement of 7 g per capita daily of apple pectin in the daily ration had 12.02% lower fat thickness measured at x2 point and 2.1% greater thickness in *m. long. dorsi*. The inclusion of apple pectin increased the number of lymphocytes by 7.162 G/L and reduces the levels of triglycerides and ”bad cholesterol”, with a direct impact on the immune defense and the health status of the circulatory system.

Key words: fattening pigs, apple pectin, fat thickness, blood.

Introduction

In modern schemes for feeding pigs, in addition to the main raw materials, various feed additives are used, the purpose of which is to support the absorption of nutrients and improve the health of the animals. These feed additives can be of natural origin or synthetic. In the most general terms, feed additives are substances, microorganisms or preparations, other than feed raw materials and premixes, which have a beneficial effect on the characteristics of the feed, satisfy the nutritional needs of animals to an optimal degree, have a coccidiostatic or histomonostatic effect and, as a final effect, lead to the promotion of health status and productivity.

Increasing efforts to replace antibiotics and improve animal health, combined with the positive role of the gut microbiota in health, have led to increased interest in fibers with prebiotic potential, formed when pectin is metabolized by microorganisms in the colon, and in their beneficial effects on animal growth and health (Zhang et al., 2022). Pectin is a major building block of the cell wall of all land plants and contains multiple molecular structures. The three major pectin polysaccharides are homogalacturonan (HG), rhamnogalacturonan-I (RG-I) and rhamnogalacturonan-II (RG-II) (Willats et all., 2001). Getting into the intestinal tract, in addition to stimulating peristalsis, it also provides a favorable environment for the development of good microflora.

The ability of pectin to absorb toxins is one of its important properties for maintaining the health of the intestinal tract (Fak et al., 2015, Min et al., 2015, Chung et al., 2017, Zhang et al., 2019.). One of the important qualities of pectin is its positive influence on the metabolism through the release of accumulated harmful substances. Pectin reduces elevated levels of "bad cholesterol" and triglycerides, while not reducing the level of good cholesterol in high-density lipoproteins. In addition, pectin also reduces the increase in blood sugar after carbohydrate intake, helps to completely clean the blood vessels and prevents the accumulation of plaques and cholesterol formation, slows down the absorption of fats and glucose. That is why it is also known as a natural remedy for maintaining the health of the circulatory system and normal blood pressure levels.

The studies of Buraczewska et al. (2007) and Schokker et al. (2018) show that pectin and fructooligosaccharides can improve small intestinal morphology in pigs. The patterns of effects of fiber on the intestinal microbiota in the small intestine, which is different from that in the large intestine, are not clear enough (Mu et al., 2017 b; Pereira and Berry, 2017). In an experiment, Feng (2017) found that pectin increased the relative abundance of Lactobacillus in the colon of weaned pigs.

Aim

The aim of the experiment was to determine the influence of apple pectin supplementation on productivity, health status and some blood parameters in fattening pigs.

Material and methods

At the Agricultural Institute – Shumen, a scientific and economic experiment was conducted with fattening pigs of the Danube White breed. The duration of the trial was 36 days. The animals were divided into two groups (control and experimental) of 13 animals, fed and bred in individual pens. Apple pectin was added to the feed of the pigs in the experimental group in the amount of 7 g per capita daily (Table 1).

On the 16th day from the start of the experiment, one of the animals in the control group dropped out due to illness.

The experiment began with an average live weight of 58.317 kg–58.846 kg and ended with an average live weight of 101.000 kg–100.831 kg, respectively, for the animals in the control and experimental group. During the whole experiment, the animals received a compound feed containing 18% of crude protein, 0.95% of lysine, 0.60% of Ca and 0.50% of P. (Table 2).

During the experiment, the following indicators were controlled: feed intake – daily, average daily gain – at the beginning and at the end of the experiment, individually; feed conversion ratio per kg gain – for the entire period; health status – daily.

At 185–190 days of age, the percentage of lean meat in the carcass was determined *in vivo* using a Pig log 105, using the following regression model:

$$LM = 63.8662 – 0.4465x_1 – 0.5096x_2 + 0.1281x_3,$$

Table 1. Experiment scheme

Group I (control – 13 animals)	Group II (experimental – 13 animals)
Compound feed	Compound feed
-	7 g pectin per capita daily

Table 2. Compound feed components

Components	I and II group, %
Maize	23.88
Wheat	45.00
Barley	5.00
Soybean meal	24.50
Synthetic lysine	0.07
Limestone	1.10
Premix	0.25
Salt	0.20
Total	100.00

where:

x_1 – fat thickness measured between the 3rd and 4th lumbar vertebra at 7 cm lateral (mm);

x_2 – fat thickness measured between the last 3rd and 4th ribs at 7 cm lateral (mm);

x_3 – thickness of *m. long. dorsi* between the last 3rd and 4th ribs at 7 cm lateral (mm).

In order to determine the effect of pectin supplementation on blood parameters (complete blood count, Urea, Triglycerides and Cholesterol), at the end of the study, blood was taken from each pig from the orbital venous sinus using a closed system method. All samples were collected in plastic blood collection tubes (Vacusera, Izmir, Turkey) and immediately inverted 10 times. Samples for serum biochemistry were collected in serum tubes and allowed to clot at room temperature for 2–3 h before centrifugation (2000 × g for 15 min). Serum was collected and stored at -20 °C for subsequent biochemical analysis. Whole blood samples were collected in EDTA tubes and stored at room temperature for hematological analysis within 6 h of sampling. Analytical blood count procedures were performed with a SYSMEX XS 500i 5-type differential count automatic hematology analyzer (Sysmex Europe GmbH, Norderstedt, Germany) and a Selectra Pro XL automatic biochemical analyzer (ELITech Group, Puteaux, France) in accordance with the instructions of the manufacturer. These include the study of triglycerides, cholesterol, urea, determination of leukocytes (WBC) by conductometric and visual optical method, erythrocytes (RBC) by conductometric method, hemoglobin (HGB) by cyan-methemoglobin method, hematocrit (HCT) by indirect based on method of conductometric analyses, mean number of red blood cells (MCV) by conductometric method, mean content of hemoglobin in erythrocytes (MCH), mean concentration of hemoglobin in erythrocytes (MCHC).

Results and discussion

The analysis of the results from Table 3 shows that the pigs of group II consumed an average of 41 g less compound feed, which also led to a lower intake of ME, protein and lysine. However, the differences found were low and insignificant.

There is an identical trend in regards to the average daily gain, which in the pigs of group I was 19 g higher compared to those that received pectin as a supplement to the ration.

The feed conversion ratio was slightly higher (by 42 g) in animals from the experimental group. As can be seen, the obtained results are practically insignificant and the addition of pectin had no effect on the growth rate of the pigs. According to Hedemann (2006), increased luminal viscosity and water-binding capacity increased satiety in pigs, resulting in lower feed intake. On the other hand, it is possible that the citrus pectin included in the ration had a negative effect on the taste of the ration.

Table 3. Feed intake and fattening qualities

Indicators	I /n = 12/	II /n = 13/
Feed intake, average per capita daily, kg		
$\bar{x}$	3.109	3.068
%	100.00	98.68
ME, MJ*	40.602	40.066
Protein	55.960	55.221
Lysine	2.953	2.914
Live weight, kg		
At the beginning of the experiment	58.317	58.846
At the end of the experiment	101.000	100.831
Average daily gain, g		
$\bar{x}$	0.809	0.790
%	100.00	98
$S^{\bar{x}}$	0.026	0.049
Feed conversion ratio per kg gain, kg	3,842	3,884
ME, MJ*	50.663	53.495
Protein	69.827	73.730
Lysine	3.685	3.891

**Metabolizable energy*

The results we obtained, regarding the back fat thickness indicator measured with PIGLOG 105, are reflected in Table 4, from which it can be seen that the phenotypic value of the back fat thickness trait at point x1 in animals from group I is higher with 3.4% compared to that measured in group II animals.

The back fat thickness measured at point x2 is characterized by insignificantly lower values (12.02%) in animals from the second group compared to those of the first group. For pigs from the experimental group, the value of the trait *m. long. dorsi*, thickness cm² was higher by 2.1% respectively compared to the control group.

In a study conducted with a food supplement, rich in pectin substances (dried apples, aronia, currants, strawberries and carrots), the authors Marek Pieszka et al. (2017) found a reduction in back fat thickness in fattening pigs.

Research by Lagreca and Marotta (1985) showed that the addition of 4% pectin in the finishing period had equal feed utilization compared to our control group. The average back fat thickness in pigs receiving pectin was 2 mm (8%) lower than that in the control group.

The animals that received the pectin supplementation (group II) had a slightly higher percentage of lean meat with 1.1%. Despite our positive results regarding the fat percentage and lean meat percentage, determined in vivo, the differences between the groups are not significant and needed further more detailed studies on the effects of pectin on carcass and meat composition.

The results of the hematological analysis, presented in Table 5 show certain differences between individual blood parameters, the most significant of which are the number of lymphocytes, platelets and cholesterol.

The number of leukocytes (24,854 G/L) in pigs from the experimental group slightly exceeded the values of those of the control group (23,417 G/L), but the difference was insufficient to confirm a definite influence of pectin supplement on this indicator. In contrast, the difference in lymphocyte levels (7.162 G/L) was significant. It is known that the main function of lymphocytes is to support hemostasis, with a direct influence on immune defense and the synthesis of immunoglobulins. They also participate in inflammation by secreting cytokines and chemokines, molecules that the immune system uses as chemical messengers to promote the interaction, communication, and behavior of cells in the immune system.

No significant differences were observed regarding the values of monocytes and granulocytes, which did not show a noticeable effect of pectin on their quantity. Erythrocyte values followed the same trend, being slightly higher in control animals (7.118 T/L) compared to experimental (7.043 T/L). The close levels of erythrocytes can be explained by the equal motor activity of the pigs, leading to equal consumption of nutrients and oxygen transported by erythrocytes. In both groups, the values of erythro-

Table 4. Back fat thickness

Indicator	Group I control	Group II Experimental + 7 g pectin per capita daily
X1, mm		
$\bar{x}$	14.333	13.846
$S_{\bar{x}}$	1.202	0.933
X2, mm		
$\bar{x}$	10.667	9.385
$S_{\bar{x}}$	0.890	0.572
∑ X1 + X2, mm		
$\bar{x}$	25.000	23.231
$S_{\bar{x}}$	1.859	1.392
MLD, cm² *		
$\bar{x}$	50.083	51.154
$S_{\bar{x}}$	1.433	1.815
LM, % **		
$\bar{x}$	58.358	59.015
$S_{\bar{x}}$	1.011	0.839

**MLD – m long. dorsi*
***LM – lean meat*

cytes are within the physiological norms and are close to those of Nikolova et al. (2015). A trend towards higher values in control animals (66,250 G/L) was found in platelet counts. In addition to their blood clotting function, platelets contain histamine and serotonin, directly related to the normal function of the digestive system.

Important indicators that characterize lipid metabolism are the levels of triglycerides and cholesterol (Markova et al., 2018). The levels of serum triglycerides were approximately the same, the lower values in animals fed with pectin (0.167 mmol/L) compared to those that consumed feed without supplementation (0.172 mmol/L) did not give grounds for the presence of an effect from the addition of pectin on serum triglyceride levels. A noticeable effect of the addition of pectin to the ration of fattening pigs was observed in the amount of cholesterol, which was 0.305 mmol/L lower in the pigs of the experimental group. This trend is logical, considering that the main role of pectin is to reduce the increased levels of "bad cholesterol" and triglycerides, without reducing the level of good cholesterol in high-density lipoproteins.

In addition, pectin also reduces the increase in blood sugar after carbohydrate intake, helps to completely clean the blood vessels and prevents the accumulation of plaques and cholesterol formation, slows down the absorption of fats and glucose. That is why it is also known as a natural remedy for maintaining the health of the circulatory system and normal blood pressure levels.

Urea values also showed no significant differences between the two groups. Considering the fact that the level of urea in the blood is an indicator of the digestibility of protein from the ration, we can assume that the digestibility of protein in both groups of pigs is practically the same.

Conclusions

- The addition of 7 g per capita daily of pectin in the compound feed of fattening pigs of the Danube White breed did not have a positive effect on the growth intensity and the utilization of the feed.
- The inclusion of pectin insignificantly decreased fat thickness measured at point x2 by

Table 5. Hematological indicators

Indicators	Units	Group I Control		Group II Experimental	
		$\bar{x}$	$S^{\bar{x}}$	$\bar{x}$	$S^{\bar{x}}$
Leukocytes (WBC)	G/L	23.417	0.827	24.854	1.029
Lymphocytes (LYM)	G/L	14.292	0.579	21.454	5.930
Monocytes (MID)	G/L	2.158	0.371	2.277	0.266
Granulocytes (GRAN)	G/L	6.967	0.383	6.808	0.596
Erythrocytes (RBC)	T/L	7.118	0.109	7.043	0.102
Hemoglobin (HGB)	g/L	126.833	2.236	121.692	1.681
Hematocrit (HCT)	L/L	0.430	0.008	0.413	0.007
Platelets (PLT)	G/L	416.250	41.823	350.000	25.137
Thrombocrit (PCT)	L/L	0.228	0.013	0.243	0.015
Triglycerides	mmol/l	0.172	0.020	0.167	0.010
Cholesterol	mmol/l	1.857	0.144	1.552	0.070
Urea	mmol/l	6.267	0.334	6.200	0.408
LDL Cholesterol	mmol/l	1.061	0.126	0.809	0.043
HDL Cholesterol	mmol/l	0.722	0.036	0.695	0.048

12.02% and increased the thickness of *m. long. dorsi*, by 2.1% compared to control animals.

• The added supplement increased the number of lymphocytes by 7,162 G/L, and reduced the levels of triglycerides and the so-called ”bad cholesterol”, with a direct impact on the immune defense and the health status of the circulatory system.

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