

Physiological response of turkeys fed diets with a different content of fructooligosaccharides

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Abstract

The present study was carried out to determine the effects of a different content of fructooligosaccharides (FOS) on the performance and intestinal metabolism in turkeys. Diets containing 0%, 0.5%, 1% and 2% of FOS, fed to turkeys for 8 weeks, had no effect on feed intake, body weight and feed conversion. The highest FOS content significantly increased the weight of caecal digesta, and lowered the ileal and caecal pH, in comparison with the control group. FOS had no significant effect on the activity of microbial enzymes in the caecal digesta. The highest FOS addition enhanced the production of volatile fatty acids in the caeca (400.9 vs. 284.8 $\mu\text{mol/kg BW}$), especially butyrate (117.5 vs. 66.3 $\mu\text{mol/kg BW}$), in comparison with the control group. Compared to the highest FOS content (2%), the levels of 0.5% and 1% had no significant effect on the intestinal parameters of turkeys.

Introduction

In the last decade FOS were extensively studied for their ability to improve animal health and performance. In our earlier experiments [3], the addition of low doses of FOS (0.4%) had no significant effect on the body weights of turkeys, and negligibly changed SCFA concentration in the caecal digesta. A higher dose of FOS added to a broiler diet (2%) had no effect on the pH in the upper segments of the gastrointestinal tract, but reduced the caecal pH by 0.4 units [2]. Also a diet containing 2% of thermally produced kestose had no effect on weight gains, feed conversion and the count of intestinal microflora [5]. This shows that the physiological effects of dietary FOS have not been sufficiently investigated, especially in turkeys, which are sporadically used in experiments on diet supplementation with oligosaccharides. Thus, the aim of the present study was to determine and compare the effects of higher concentrations (0.5, 1% and 2%) of FOS in a diet for turkeys on their performance and intestinal parameters.

Material and Methods

The 8-weeks experiment was conducted on 320 three-day-old BUT-9 male turkey poults, randomly assigned to one of four dietary treatments (four replications with 20 poults in each group). The poults were given free access to mash diets formulated to meet nutrient requirements of turkeys [4]. The basal diet was supplemented with 2% of wheat (control group) or 1.5%, 1% and 0% of wheat and 0.5%, 1% and 2% of FOS (FOS-0.5, FOS-1 and FOS-2, respectively). As source of FOS preparation of Raftilose P95 (ORAFIT, Belgium) was used.

After 8 weeks of experiment feeding, eight turkeys representing an average body weight of each group were killed. The selected parts of the digestive tract were removed and weighed. Ileal and caecal pH was measured using a microelectrode and pH/ION meter (model 301, Hanna Instruments). Samples of fresh digesta were used for chemical analysis. Microbial enzyme activity in the caecal digesta was measured by the rate of p- or o-nitrophenol release from their nitrophenylglucosides [1]. The VFA concentration was analysed by gas chromatography (Shimadzu GC-14A with a glass column 2.5 m \times 2.6 mm, containing 10% SP-1200/1% H₃PO₄ on 80/100 Chromosorb W AW, column temperature 110°C, detector

FID temperature 180oC, injector temperature 195oC). The results were analysed using one-way ANOVA and the Duncan's multiple range test.

Results and Discussion

Diet supplementation with FOS had no significant effect on feed intake, body weight and feed efficiency ratio (Table 1). This is consistent with the results of an experiment performed on broilers fed a diet containing 2% of kestose [5]. However, the results of another experiment on broiler chickens were quite different - 1% addition of inulin or oligofructose appeared to increase both body weight and feed conversion [6]. Similarly to results of other experiments on poultry [2], the addition of FOS increased the bulk of caecal digesta. In our experiment the weight of caecal digesta was higher in the group fed a diet with 2% of FOS than in the control group. The highest FOS content increased the hydration of ileal digesta. The lowest pH of ileal and caecal digesta was recorded in the FOS-2 group. As for the pH of caecal digesta, its level was similar to that obtained by Farnworth et al. [2] who reported that a diet with 2% of FOS reduced the caecal pH in broilers by 0.4 units. However, contrary to the results of their experiment [2], in our study the addition of FOS reduced the pH of ileal digesta. In the present study, microbial enzyme activity was unaffected by dietary treatment. In our earlier experiments [3], a small dose of FOS (0.4%) did not increase the microbial enzyme activity in the caecal digesta of turkeys, either. There were no significant differences in the concentration of VFAs in the caecal digesta. The highest values of the total VFA pool and butyrate pool were observed in the group fed the FOS-2 diet. Higher total amounts of VFA determined in this group indicated an increased activity of bacteria in the caeca of turkeys fed a diet supplemented with 2% of FOS. This is consistent with the results reported by Yusrizal et al. [6]. Contrary to the results of their experiment [6], in our study a lower FOS content of the diet (0.5% and 1%) influenced the production of VFAs in the caeca of turkeys to a lower degree.

Conclusion

Diet supplementation with a low level of FOS (0.5% and 1%) had no significant effect on intestinal physiology in turkeys. The increase in FOS concentration to 2% was followed by an increase in the amount of caecal digesta, enhanced production of VFAs and a reduction in the pH of digesta, but had no influence on feed intake and the growth rate of turkeys.

References

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Table 1. Indices of the physiological response of turkeys to dietary treatment

	<u>Dietary treatment</u>				Pooled SEM
	Control	FOS-0.5	FOS-1	FOS-2	
Diet intake, kg	6.60	6.48	6.55	6.69	0.08
BW at 8 weeks, kg	3.85	3.93	3.86	3.88	0.05
FCR 1-8 weeks, kg/kg	1.74	1.72	1.76	1.72	0.03
Weight of digesta					
- ileal, g/kg BW	22.40	22.41	22.72	25.93	1.01
- caecal, g/kg BW	3.59 ^b	3.89 ^{ab}	3.79 ^{ab}	4.73 ^b	0.16
Dry mater of digesta					
- ileal, g/kg BW	15.21 ^{ab}	15.60 ^{ab}	16.37 ^a	14.20 ^b	0.27
- caecal, g/kg BW	16.56	16.20	18.59	17.39	0.44
pH of digesta					
- ileal	6.04 ^a	5.82 ^{ab}	5.75 ^a	5.23 ^b	0.10
- caecal	6.13 ^a	5.89 ^{ab}	5.79 ^a	5.49 ^b	0.13
Microbial enzyme activity¹, U/g					
- α -glucosidase	0.81	0.69	0.82	1.06	0.06
- β -glucosidase	0.22	0.10	0.19	0.14	0.02
- α -galactosidase	0.90	0.62	0.99	0.93	0.08
- β -galactosidase	1.66	1.16	1.75	1.43	0.18
- β -glucuronidase	0.51	0.52	0.43	0.39	0.06
VFA concentration¹, μmol/g					
- acetate	53.8	55.6	54.7	52.4	1.90
- propionate	4.28	4.21	5.36	3.34	0.35
- iso-butyrate and butyrate	20.3	24.4	24.0	26.1	1.42
- iso-valerate and valerate	2.70	2.94	3.36	3.17	0.32
- total	81.1	87.1	87.4	85.1	3.19
VFA pool¹, μmol/kg BW					
- acetate	189.8	211.4	201.7	248.1	10.7
- propionate	15.0	17.7	19.5	15.4	1.49
- butyrate	66.3 ^b	87.2 ^{ab}	85.3 ^{ab}	117.5 ^a	7.03
- total	284.8 ^b	331.0 ^{ab}	323.2 ^{ab}	400.9 ^{ab}	17.9

¹In the caecal digesta, ^{a,b}Means within rows with no common superscript are different at P \leq 0.05