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Effects of Dietary Inclusion of a *Saccharomyces cerevisiae* Fermentation Product on Performance and Gut Characteristics of Male Turkeys to Market Weight

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Abstract: An experiment was conducted to test the effects of different levels of a *Saccharomyces cerevisiae* fermentation product on the performance and gut characteristics of male turkeys to 18 weeks of age. Turkeys were housed in a 32 pen facility (800 birds) with eight replicates and three levels (0.0625, 0.125, 0.25%) of XPC (Diamond V Mills) compared to a negative control without XPC. Experimental parameters measured included: body weight, feed intake, feed conversion, mortality and gut parameters (villi height, crypt depth, gut section histopathology). Processing yield was measured at the conclusion of the trial. All other diets and husbandry practices were based on industry standards. Feed efficiency was significantly improved in the 15-18 week period at all treatment levels (2.64 vs. 2.76 feed: gain at 18 weeks). No other differences in performance parameters measured were observed. Pectoralis major yield was higher in all treatment groups (19.9% vs. 20.7%) when compared to controls. No statistical differences were seen in gut samples in terms of gut scores, villi height, or crypt depth. The data reported here indicates that supplementing the diet with XPC may have a positive effect on the feed efficiency and breast meat yield of tom turkeys but that further studies are needed to define this effect.

Key words: *Saccharomyces cerevisiae*, turkey, breast yield, feed efficiency

INTRODUCTION

Yeast cultures have been reported to potentially to increase immunity, improve gut health and consequently bird performance, in the absence of antibiotics (Gao *et al*., 2009). *Saccharomyces* has demonstrated antagonistic activity against various bacterial pathogens both *in vitro* and *in vivo* (Jensen *et al*., 2008). When properly applied, *Saccharomyces* treatment results in the diminished presence of various pathogens in the intestinal tract of live animals (Gao *et al*., 2008).

Utilization of immune stimulants is one solution to improve the immunity of animals and to decrease their susceptibility to infectious disease. Utilization of live yeast has been demonstrated to improve gut maturation in sea bass larva (Tovar-Ramiriz *et al*., 2004). Yeast culture is defined as a fermented product of liquid and cereal grain ingredients by *Saccharomyces cerevisiae* yeast. Dietary supplementation of yeast culture has been practiced in ruminants to improve milk production of dairy cows (Robinson and Garrett, 1999) and feed intake of beef cattle (Cole *et al*., 1992). However, effects of yeast culture supplementation in turkey diets have not been well investigated. Considering its effects on ruminants, swine and aquaculture, yeast culture could be beneficial to poultry as well.

The purpose of this experiment was to examine whether the Diamond V XPC yeast fermentation product is able to improve performance of turkeys through improvements in gut morphology when fed to turkeys in a simulated commercial environment

MATERIALS AND METHODS

An experiment was conducted using Nicholas male turkeys housed on used litter in curtain-sided buildings that simulate standard industry conditions. Turkeys were housed in a 32 pen facility (800 birds) with 8 replicates and 3 levels of XPC compared to a 4th treatment with no XPC added. Experimental parameters measured included: body weight, feed intake, feed conversion, mortality and gut parameters (villi height, crypt depth, gut section histopathology).

Dietary treatments included: T1, no XPC; T2, XPC at the recommended dose (0.125%, from 0-6 wks, then 0.625% to finish); T3, XPC at 2x the recommended dose (0.25%, from 0-6 wks, then 0.125% to finish) and T4, XPC at 3x the recommended dose (0.375%, from 0-6 wks, then 0.19% to finish).

Birds were housed in a 32 pen two-stage turkey facility at the University of Missouri, Columbia, MO, USA. The facility is a curtain-sided building similar to those seen in industry. Standard animal husbandry practices were followed. All procedures were based on University of Missouri Standard Operating Procedures and were

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approved by the Animal Care and Use Committee. Birds received light for 23h per day and were provided feed and water *ad libitum*. Birds and feed were weighed at 3-week intervals to 18 weeks. Feed intake was measured at each time and the feed:gain ratio was calculated. Mortality was monitored daily and dead bird weight was used to adjust feed conversion. A standard corn-soy-animal products diet based on AgriStats industry average was used with the exception of the addition of the yeast fermentation product. A single diet was mixed and split for product addition where possible. All feed was provided to birds as mash. At the conclusion of the trial, 3 turkeys per pen (24 per treatment) were processed for yield evaluation.

Data were analyzed by analysis of variance (ANOVA) with a randomized complete block design using the general linear model. Generally block effects are not significant and this portion of the variance was added into the error mean square. Following ANOVA treatment means were separated by LSD where appropriate. All data were analyzed with the JMP version of SAS (SAS Institute Inc., Cary, NC, USA). The level of significance was set at 0.05.

Measurement of Ileal Mucosa

Villi measurements: At 21, 28 and 84 day of the feeding trial, four birds per treatment were selected at random and euthanized by CO_2 asphyxiation followed by cervical dislocation. Intestinal samples were taken (5 cm sections) from the duodenum and also from the ileal segment between Meckel's diverticulum and the ileocolic-cecal junction. The small intestine was dissected from the mesentery then segments were removed and dissected longitudinally. Samples were fixed in 10% buffered formalin and embedded in paraffin. Three micron sections were microtome cut and stained with haematoxylin and eosin. Slides were measured with light microscopy to measure crypt depth, villi height and villi width at the crypt/villus junction and tip. Ten villi per sample were measured and a mean calculated.

RESULTS

The trial was completed as designed. Performance results are presented in Table 1. Performance of birds was good with 18-week weights of greater than 16 kg. No differences were seen in performance of the turkeys in the early growth periods. Feed efficiency was significantly improved during the final period and for the trial with 10-12 points of improvement for the entire trial relative to the control treatment (T1) with no XPC addition.

A significant increase in breast meat yield (both pectoralis major and total breast yield) was also seen. No other differences were seen in processing yield of turkeys (Table 2).

A variety of measurements were taken of the gut to determine if gut health was enhanced. No differences were seen in gut samples in terms of gut scores, villi height, or crypt depth (Table 3).

DISCUSSION

This experiment demonstrates that the *Saccharomyces cerevisiae* fermentation product (Diamond V XPC) has some potential benefits in terms of feed efficiency with over 10 points of improvement in feed:gain ratio seen in this trial. These data are consistent with those of Gao *et al*. (2008) suggesting the effects seen will be realized over a period of time. Positive effects have also been seen in poultry that were stressed either through

Table 1: Body weight gain and feed efficiency from 3 to 18 weeks of age

	Gain (kg)							FE (kg: kg)					
Trt	3	6	9	12	15	18	<wk>	3	6	9	12	15	18
T1 Ctrl	0.54	2.36	5.56	9.29	12.97	16.13		1.69	1.72	1.78	2.07	2.40	2.76[a]
T2 XPC_{1X}	0.54	2.35	5.42	9.34	12.88	16.42		1.68	1.70	1.84	2.05	2.34	2.64[b]
T3 XPC_{2X}	0.55	2.34	5.43	9.21	12.79	16.24		1.59	1.69	1.86	2.07	2.42	2.65[ab]
T4 XPC_{3X}	0.55	2.36	5.53	9.18	13.12	16.61		1.68	1.741	1.84	2.08	2.40	2.66[ab]
SE	0.02	0.05	0.06	0.10	0.21	0.13		0.04	0.03	0.03	0.02	0.03	0.03
P-value	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05		>0.05	>0.05	>0.05	>0.05	>0.05	<0.05

Different letters indicate significantly different means

Table 2: Percentage hot carcass yield, legs, thighs, wings, pectoralis and fat pat at 18 weeks of age of tom turkeys

	BW (%)				Pectoralis		
	Carcass	Legs	Thighs	Wings	Major	Total	Fat pad
TRT							
T1-Ctrl	77.29	9.85	10.46	9.84	19.08_a	23.3_a	2.12
T2-XPC_{1x}	77.73	9.84	9.88	9.75	19.95_{ab}	24.2_{ab}	2.41
T3-XPC_{2x}	77.59	9.97	10.38	10.27	20.46_b	24.6_b	2.44
T4-XPC_{3x}	78.41	9.94	10.10	10.31	21.02_b	25.0_b	2.86
SE	0.52	0.64	0.30	0.60	0.55	0.40	0.19
P value	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	>0.05

Different letters indicate significantly different means

Table 3: Effect of different levels of XPC on gut parameters (Villi height, crypt depth, villi-crypt score, villi height/crypt depth) of turkeys at 21, 28 and 84 days

TRT	21 d villi	21 d crypt	21 d score	21 d v/c	28 d villi	28 d crypt	28 d score	28 d v/c	84 d villi	84 d crypt	84 d score	84 d v/c
T1-Ctrl	569	113	1.00	5.1	970	124	1.00	7.8	1088	109	0.0	10.5
T2-XPC 1x	487	97	0.87	5.1	1020	126	1.38	8.1	1051	106	0.25	10.2
T3-XPC 2x	576	110	0.87	5.5	1030	121	1.13	8.6	1101	109	0.38	10.8
T4-XPC 3x	560	118	0.86	4.9	1137	135	1.14	8.4	1184	97	0.0	12.2
+/-SE	39	7	0.11	0.48	70	5.4	0.13	0.5	84	8.7	0.13	1.1
Signif	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

coccidial infection (Stanley *et al*., 2004; Lensing *et al*., 2008) or when exposed to aflatoxin (Huff *et al*., 2007; Osweiler *et al*., 2010). These results suggest that S. cerevisiae fermentation products may improve the ability of the bird to handle stress. It has been shown that XPC and similar products have an immune modulating impact on broilers both in standard production situations and during a challenge (El-Husseiny *et al*., 2008; Gao *et al*., 2008, 2009). This positive effect on the immune system may be partially responsible for the improved feed efficiency seen in this study. *Saccharomyces cerevisiae* fermentation products are also known to have a positive impact on intestinal morphology in various animals (Al-Homidan *et al*., 2007; Shen *et al*., 2009). It has been postulated that some of the benefits in performance when XPC is fed may be due to benefits to intestinal health.

Dietary supplementation of yeast culture products has been practiced in ruminants to improve milk production of dairy cattle (Robinson and Garrett, 1999) and feed intake of beef cattle (Cole *et al*., 1992). Van Der Peet-Schwering *et al*. (2007) found positive effects in weanling pigs in terms of several gut parameters as well as feed efficiency. Gao *et al*. (2008) found a positive effect in broilers as well. These data would support the positive effects seen in other species. The data reported here indicates that supplementing the diet with the Diamond V XPC had a positive effect on feed efficiency and breast meat yield in turkeys.

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