

# Effect of feeding whole or ground wheat grain on the weight of the gizzard and pH of digesta in broiler chickens

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## ABSTRACT

In an experiment carried out on 384 broiler chickens, the following parameters were compared: weight of the gizzard, pH of the digesta in the gizzard and in the small intestine, as well as the extent of digesta disintegration in this part of the digestive tract. The birds were fed diets containing either whole or ground wheat grain. In addition, the effect of an enzymatic preparation containing xylanase on the examined parameters was determined. It was found that whole grain fed to broiler chickens increased the weight of the gizzard, decreased the pH of the digesta in the gizzard and increased the pH in the small intestine. The physical form of the wheat grain was not found to influence the degree of digesta disintegration in the small intestine.

KEY WORDS: chickens, whole wheat, xylanase, gizzard, digesta pH

## INTRODUCTION

Poultry is capable of utilizing whole cereal grain because intensive grinding and disintegration take place in their gizzards (Svihus et al., 1997a). The use of whole grain is more natural (Covasa and Forbes, 1996) as it increases the weight of the gizzard and improves the functioning of the gastrointestinal tract (Ristic et al., 1994; Salah Uddin et al., 1996) and this, in turn, has a positive influence on the general health of flocks (Forbes and Covasa, 1995). The proper diet for poultry contains cereals, which are usually ground and, in this physical form, incorporated into the feed mixture. Grinding and transportation costs increase the initial price of cereals by even over 20%.

Literature on the subject discusses four methods of poultry feeding with whole grain: the method of "free choice" (Cumming and Ball, 1995; Forbes and Covasa, 1995), the so-called "Danish system" (Best, 1993) which consists of "thinning" the mixture with whole wheat grain, the "follow-up" system in which the high protein mixture is followed by whole grain (Rose, 1996) and partial or total replacement of the cereal meal in the diet by whole grain (Gill et al., 1998).

The objective of this study was to compare the degree of disintegration of particles in small intestinal digesta of chickens fed mixtures with whole or ground wheat grain and to assess the influence of an enzymatic preparation used to counteract anti-nutritional substances found in wheat.

## MATERIAL AND METHODS

The experimental material comprised on 384 Cobb 500 broiler cockerels obtained from the Poultry Hatchery in Wierzbno; the experiment was carried out in the chicken house of the Department of Animal Nutrition and Feed Management in Gorzyń. The experiment lasted for 6 weeks divided into two feeding periods: starter (0 to 21 days) and grower (22 to 42 days). The feeding mixture was made up of: wheat either as a meal or whole grain, soyabean meal, meat meal, rape seed oil and mineral-vitamin additives. Diets fed during the starter period contained 12.9 MJ ME and 23% crude protein and those fed during the grower period, 13.1 MJ ME and 19% crude protein. The birds were randomly divided into four groups, which were kept in cages of 8 birds each. Twelve cages, i.e. 96 chickens, made up one feeding group. The following experimental designs were employed: group 1 - ground wheat; group 2 - initially - 100 g/kg whole grain increased from day 10 of life by 10% every five days so that from day 31 onwards, the experimental birds were fed mixtures only with whole grain (610 g/kg); group 3 - fed as group 1 but supplemented with an enzymatic preparation (Avizyme 1300) containing, among others, xylanase; group 4 - the similar feeding system as in group 2 but with enzymatic supplementation. Throughout the experiment, body weight gains and feed consumption were measured weekly. At the termination of the experiment (after 12 h of fasting) six birds were randomly selected from each feeding group, slaughtered and then the weight of the gizzard as well as the pH of the gizzard and small intestinal digesta were determined. The pH of the gizzard and small intestine was measured directly in digesta. A P 731 pH meter was used to assess pH. The evaluation of the extent of small intestinal digesta disintegration was carried out using the sieve method. The method involved digesta collection from the whole length of the small intestine from individual birds. The digesta was mixed well and then rinsed with lukewarm water through sieves with mesh diameters of 1.25; 1.00; 0.80; 0.63 and 0.50 mm. Molecule size was measured by the size of sieve mesh,

the smallest fraction was not analyzed because it passed into the solution completely. After drying and weighing, the percentage share of individual fractions was determined.

Statistical analysis was performed using the Statgraphics Plus ver. 6 program. It was also used for single factor analysis of variance. Differences were considered significant at  $P < 0.05$ .

## RESULTS

Table 1 presents weights of gizzards expressed in grams as well as pH values of gizzard and small intestinal digesta. Table 2 presents the results of sieve analysis in percent. The proportion of individual fractions of the small intestinal digesta is shown.

TABLE 1

Weight of gizzard in g and pH of digesta the gizzard and small intestine

Group, form of grain	Gizzard weight	SEM*	pH of gizzard digesta	SEM	pH of small intestine digesta	SEM
1 – ground	29.2 <sup>a</sup>	0.909	3.6 <sup>b</sup>	0.149	5.6 <sup>b</sup>	0.123
%	100		100		100	
2 – whole	37.5 <sup>b</sup>	0.718	2.9 <sup>a</sup>	0.159	6.2 <sup>c</sup>	0.073
%	128		80		108	
3 – ground + enzyme	25.5 <sup>a</sup>	1.204	3.1 <sup>a</sup>	0.212	5.4 <sup>a</sup>	0.099
%	100		100		100	
4 – whole+ enzyme	39.2 <sup>b</sup>	2.372	2.9 <sup>a</sup>	0.129	5.7 <sup>b</sup>	0.108
%	154		93		105	

<sup>ab</sup> values in columns designated with different letters differ significantly at  $P < 0.05$

\* standard error of mean

## DISCUSSION

The use of whole-wheat grain increased the weight of the gizzard by 28% in group 2 in comparison with control group 1; differences between these groups were significant ( $P < 0.05$ ). In group 4, similarly as in studies by Damme (1994) and Ciera et al. (1995), the use of whole wheat grain together with an enzymatic preparation was found to further increase the weight of the gizzard. The use of whole wheat grain, as in the case of investigations conducted by Ristic et al. (1994),

TABLE 2

Sieve analysis – % share of individual fractions in small intestinal digest

Diameter of particles, mm	Group				SEM*	P
	1 - ground	2 - whole	3 - ground + enzyme	4 - whole + enzyme		
>1.25	51.9	50.8	54.2	54.1	6.275	NS
1.25 - 1.00	16.7	16.5	15.5	14.2	2.500	NS
1.00 - 0.80	11.9	12.3	12.0	12.5	1.950	NS
0.80 - 0.63	13.3	13.6	14.2	14.6	1.700	NS
0.63 - 0.50	6.3	6.8	4.1	4.6	0.425	NS

\* standard error of mean

NS – non-significant

reduced the pH value of gizzard digesta and increased its pH in the small intestine. However, the obtained differences in pH values were not very high and only in the case of the pH of gizzard digesta in groups 1 and 2 were they significant.

Table 2 shows that the physical form of wheat grains did not have any influence on the extent of disintegration of small intestinal digesta. This finding is confirmed by results reported by Svihus et al. (1997a, b, c) who also did not find differences in the fractions of particles in small intestinal digesta when chickens were fed whole or ground barley grain. The supplementation of feeds with the examined enzymatic preparation (groups 3 and 4) only slightly decreased the share of the finest fraction (0.50 mm) and increased that of the coarsest one (1.25 mm) in comparison with treatments without enzyme supplementation (groups 1 and 2). However, these differences were not significant statistically. This finding is difficult to explain and requires further investigation.

In summary, it can be concluded that whole wheat grain was found to decrease the pH of gizzard digesta and increase the weight of this organ. The physical form of grain (ground or whole) did not have an impact on the degree of disintegration of small intestinal digesta.

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## STRESZCZENIE

### **Wpływ żywienia pełnym lub śrutowanym ziarnem pszenicy na masę żołądka i pH treści jelitowej kurcząt brojlerów**

U 384 kurcząt rzeźnych, żywionych dietami zawierającymi ziarno pszenicy w formie śruty lub całego ziarna, porównano masę żołądka mięśniowego, pH treści żołądka i jelita cienkiego oraz stopień rozdrobnienia treści jelita cienkiego. Badano także wpływ preparatu enzymatycznego zawierającego ksylanazę na badane parametry.

Stwierdzono, że podawanie kurczętom całego ziarna spowodowało wzrost masy żołądka mięśniowego, obniżenie pH jego treści oraz zwiększenie pH jelita cienkiego ( $P < 0.05$ ). Postać fizyczna ziarna pszenicy nie miała wpływu na wielkość cząstek w treści jelita cienkiego.