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## EFFECT OF INULIN ADDITION ON PERFORMANCE, BLOOD METABOLITES AND TISSUE FATTY ACID COMPOSITION IN BROILER CHICKENS

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### ABSTRACT

Inulin-type fructans can stimulate the Bifidobacteria and Lactobacillus development in the gut. Their activity may influence metabolism and productive results as well as improve health status of animals. Naturally occurring inulin is a storage carbohydrate, present in many plants like chicory, sunroot, garlic and dandelion. A study was conducted to evaluate the effect of inulin on performance, blood serum metabolites and fatty acids of abdominal adipose tissue and breast meat in chicken.

280 one-day-old female broiler chickens were randomly allocated into 7 treatments with 8 replicates per treatment and 5 chickens per pen. The experiment consisted of 2 × 3 factorial treatments including 2 types of extraction process (water - W or alcohol-water – AW) and 3 levels of inulin from chicory in the diet - 2, 4 or 6 g kg<sup>-1</sup> respectively. The experiment lasted 42 days.

The type of inulin did not affect BW gain (2.23 kg vs. 2.25 kg in W vs. AW) and FCR (1.74 vs. 1.72, respectively). The diets containing inulin from AW extraction decreased abdominal fat deposition (by about 4.8%) and serum total cholesterol, LDL, glucose and bilirubin concentrations more than inulin from W extraction. Dietary inulin decreased the AST and LDH activity and uric acid concentration (up to 15%) in blood serum compared with the control group. The addition of inulin (4-6 g kg<sup>-1</sup> of diet) to broiler diets increased the

hemoglobin in serum content and linolenic (18:2 n-6) acid in abdominal fat and decreased cholesterol concentration in serum and meat.

**KEYWORDS:** broilers, inulin, performance, blood metabolites, tissue.

### INTRODUCTION

Implementation of the ban on the antibiotic growth promoters use in poultry diets in the European Union has heightened searches for alternatives, such as probiotics and prebiotics (Grela and Semeniuk, 2006; Patterson and Burkholder, 2003). Prebiotics are non-degradable dietary ingredients that reach the large intestine without being hydrolyzed in the upper alimentary tract. Prebiotics benefit the host animal by stimulating the selective growth and activity of microorganisms. The growth suppression and immunomodulatory (i.e., bifidogenic) effects enable prebiotics to prevent diarrhea in young animals and promote the growth of livestock animals. Naturally occurring inulin is a storage carbohydrate, present in many plants like chicory, sunroot, garlic and dandelion. Inulin-type fructans are non-digestible oligosaccharides that are fermented in the gastrointestinal tract of animals (Ammerman, 1988). They can stimulate the Bifidobacteria and Lactobacillus development in the gut. Their activity may influence metabolism and productive results as well as improve health status of animals. Inulin can support animal performance and health by affecting nutrient digestion, gut microflora

and gut morphology, although results vary depending on composition of the basal diet, inclusion level, type of fructan, adaptation period and experimental hygienic conditions. Feeding inulin or oligofructose to broilers resulted in significantly improved zootechnical performance, particularly in female broilers due to increased absorptive capacity of the chicken gastrointestinal tract caused by increased length of both small intestine and colon (Park and Park, 2011; Yusrizal and Chen, 2003).

The aim of the study was to determine the effect of type and level of inulin preparation on performance, blood serum metabolites and fatty acids of abdominal adipose tissue and breast meat in chicken.

## MATERIALS AND METHODS

Inulin was obtained from chicory root extracted by diffusion process in hot water at 70 °C (W) or in hot water (70 °C) and then in 70% ethyl alcohol at 20 °C temperature (AW). The obtained extracts were dried and used as feed additive. All scientific procedures including animal experiments were performed in accordance with the scientific and ethical aspects (Swanson, 2008) and approved by the II Local Ethic Commission for Experiments on Animals, University of Life Sciences, Lublin, Poland. After sex identification, 280 one-day-old female broiler chickens were randomly allocated into 7 treatments with 8 replications per treatment and 5 chickens per pen. The experiment consisted of 2 × 3 factorial treatments including 2 types of extraction process (water - W or alcohol-water – AW) and 3 concentrations of inulin from chicory - 2, 4, and 6 g kg<sup>-1</sup> of diet. The experimental period lasted from 1 to 42 days. Birds were fed ad libitum with the above mentioned balanced full-feed mixtures: starter for 1-21 day and grower for 22-42 day, according to feeding standards (NRC, 1994). Body weight gains as well as feed intake and feed conversion ratio per 1 kg body gain in particular periods were estimated weekly.

The samples of feed mixtures for

laboratory analysis were collected twice in each feeding period. The feeds were analysed for basic nutrients (crude protein, crude fiber, ether extract and crude ash) contents (AOAC, 2000). On 24<sup>th</sup> and 42<sup>nd</sup> day of experiment blood samples (10 mL) for analytical tests were taken from brachial vein of 56 broiler chickens (8 birds from each group). Then, the samples were collected in tubes containing heparin as anticoagulant. In the full blood: haemoglobin content (Hb), haematocrit (Ht), white blood cell number (WBC) were determined by impedance and colorimetric methods (Provan *et al.*, 2004) using Abbacus junior measuring apparatus (Diatron Messtechnik GmbH, Vienna). A part of blood samples was centrifuged at 1 500 g for 10 min. Isolated plasma was stored at -20 °C. In blood plasma, on the basis of the method described by Tietz (1995), total protein, uric acid, triglycerides, total cholesterol and HDL-cholesterol were determined using colorimetric technique (Cormey-tests). The indicator enzymes AST, ALT, LDH and ALP activity in blood plasma were estimated by colorimetric methods using monotests manufactured by Biomaxim, biochemistry analyzer Metrolab and spectrophotometer Cary 50. Fatty acid in abdominal fat determination was performed using the gas chromatography method on a Varian CP-3800 chromatograph. The chromatograph operating conditions for fatty acid separation were: capillary column CP WAX 52CB DF 0,25 mm of 60 m length, gas carrier - helium, flow rate – 1.4 ml min<sup>-1</sup>, column temperature 120 °C gradually increasing by 20 C min<sup>-1</sup>, determination time – 127 min., feeder temperature – 160 °C, detector temperature – 160 °C, other gases – hydrogen and oxygen. Cholesterol level in abdominal fat and pectoral muscle was determined as per Zhang *et al.* (1999). Data were analysed with analysis of variance (ANOVA) procedure of Statistical Analysis System (SAS, 1996).

## RESULTS AND DISCUSSION

The type of inulin did not affect BW gain (2.23 kg vs. 2.25 kg in W vs. AW) and FCR (1.74

vs. 1.72, respectively). Whereas Park and Park (2011) in the studies where microencapsulated inulin at 200 g ton<sup>-1</sup> or 250 g t<sup>-1</sup> was used, reported improved growth performance and decreased abdominal fat content. The diets containing inulin from AW extraction decreased abdominal fat deposition (by about 4.8%) and serum total cholesterol, LDL activity, glucose and bilirubin concentration more than inulin from W extraction. Dietary inulin declined the AST and LDH activity and uric acid concentration (up to 15%) in blood serum compared to the control group. The addition of inulin (4-6 g kg<sup>-1</sup> of diet) to broiler diets elevated hemoglobin level in serum content and linolenic (18:2 n-6) acid in abdominal fat, while reduced cholesterol concentration in serum and meat.

Alike, the studies of Yusrizal and Chen (2003) have also confirmed that inulin feed supplement contributes to decreased cholesterol content in blood serum. Velasco *et al.* (2010) highlighted that combined inulin and sunflower oil additive improves the PUFA/SFA ratio in muscle fat.

## CONCLUSION

Inulin obtained by water-alcohol extraction provided better results as compared to that resulting from water extraction treatment. Therefore, addition of water-alcohol inulin extract at amount of 4-6 g per kg mixture is recommended, however further experiments are recommended.

## REFERENCES

**AMMERMAN, E.Q.** (1988) Broilers response to the addition of dietary fructooligosaccharides. *Poultry Science* 67:46.

AOAC (2000) Official Methods of Analysis, International, 17<sup>th</sup> Ed., AOAC Int., Gathersburg, MD, USA.

**GRELA, E.R. and SEMENIUK V.** (2006) The consequences of the withdrawal of antibiotic growth promoters in animal nutrition. *Medycyna Weterynaryjna* 62:502-507.

**NRC** (1994) Nutrient Requirements of Poultry. Ninth Revised Edition. Washington, D.C.,

National Academy Press.

**PARK, S.O. and PARK B.S.** (2011) Effect of dietary microencapsulated-inulin on carcass characteristics and growth performance in broiler chickens. *Journal of Animal and Veterinary Advances* 10:1342-1349.

**PATTERSON, J.A. and BURKHOLDER, K.M.** (2003) Application of prebiotics and probiotics in poultry production. *Poultry Science* 82:627-631.

**PROVAN, D., SINGER, C.R.J., BAGLIN, T. and LILLEYMAN, J.** (2004) Oxford handbook of clinical haematology. Oxford Handbooks Series. SAS (1996) Institute SAS user's Guide, Version 6.11, Edition SPS Institute INC., Cary, NC.

**SWANSON, J.C.** (2008) The ethical aspects of regulating production. *Poultry Science* 87:373-379.

**TIETZ, N.W.** (1995). Clinical Guide to Laboratory Tests, 3<sup>rd</sup> Edition, WB Saunders Company, Philadelphia.

**VELASCO, S., ORTIZ, L.T., ALZUETA, C., REBOLÉ, A., TREVIÑO, J., RODRÍGUEZ, M.L.** (2010) Effect of inulin supplementation and dietary fat source on performance, blood serum metabolites, liver lipids, abdominal fat deposition, and tissue fatty acid composition in broiler chickens. *Poultry Science* 89:1651-1662.

**YUSRIZAL, Y. and CHEN, T.C.** (2003) Effect of adding chicory fructans in feed on broiler growth performance, serum cholesterol and intestinal length. *International Journal of Poultry Science* 2:214-219.

**ZHANG, R.Z., LI, L., LIU, S.T., CHEN, R.M. and RAO, P.F.** (1999) An improved method of cholesterol determination in egg yolk by HPLC. *Journal of Food Biochemistry* 23:351-361.