The Effect of Natuzymein the Diets Containing Non-Starch Polysaccharides on Meat Quality of Native Chicken

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Abstract. The purpose of this research was to determine the effect of the use of Natuzyme in feed containing non-starch polysaccharides on the quality of chicken meat. Materials used were 71 native hens of 18 week-old. The experiment was conducted using Completely Randomized Design (CRD), 3 x 3 factorial pattern. Each treatment was repeated three times and was tested further with Duncan t test. The first treatment was the use of non-starch polysaccharides (R) with the levels of 0, 5 and 10%. The second treatment was the use of Natuzyme (S) with the levels of 0, 0.1 and 0.2%. The variables measured were: energy consumption, fat consumption, carcass weight, meat glycogen, meat fat, and cholesterol of meat. The results showed that the treatments did not significantly affect energy consumption, fat consumption, carcass weight and fat content of meat. The use of non-starch polysaccharides did not significantly affect the levels of meat glycogen, while the use of Natuzyme significantly affected the levels of meat cholesterol. The conclusion is that the Natuzyme only works on feedstuffs, not in the chicken digestive tract. The sources of non-starch polysaccharide in feedstuffs can be used as an energy source for chickens until a level of 10%.

Key Words: Natuzyme, non-starch polysaccharides, meat quality

Introduction

The quality of poultry meat usually is targeted on the carcass of poultry that meets standard requirements such as conformation, size, amount of meat, fat content, color and freshness. Consumers usually prefer poultry meat with red color, pH of 5.1 to 6.1, high meat tenderness, and low in fat. Chemical quality of meat according to Lawrie (1995) is reflected by the composition of the food substances with water content of 75 %, protein of 19%, fat of 2.5%, 1.2% of carbohydrate, and non-protein substances of 2.3%. The composition is highly variable and influenced by the quality and quantity of feed, ration, gender, health and age of chicken.

Chicken feed comes from grains that contain high-quantity of non-starch polysaccharides that can affect the digestive process. Non-starch polysaccharides affect the digestibility of feed in chicken and increase digesta viscosity (Annison, 1993). Polysaccharide is an important fiber in the feed material for livestock because it will reduce verticulosis (sores in the digestive tract) as well as cancer of the colon because it will shorten the fiber contact with the digestive tract therefore, will reduce the risk of the emergence of the disease. Fiber slows the absorption rate of glucose and fat from the intestine and thereby reduces the risk of diseases of the blood vessels. The physical properties of polysaccharides as a whole, are as physiological stimulator of organ activity of the gastrointestinal tract, activator of microorganisms in the large intestine (Varel and Pond, 1985), stimulator of acidity (pH) of caecal fluid (Roediger, 1982), accelerator of the movement of food in the small intestine that results in decreased absorption of nutrients (Rainbird and Low, 1986; Anderson, 1985; Zdzislaw et al., 1986).

Grains also contain anti-nutritive factors, the use of grains becomes optimum when added with enzymes in the feed. The use of Natuzyme in poultry, especially chicken feed as a feed additive is because the enzyme is cheap, safe,

and capable of reducing anti-nutritional factors, especially in the basal feed of chicken. Natuzyme is a xylanase enzyme, that is a group of enzymes that have the ability to hydrolyze hemicellulose, in this case xylan or polymers of xylose and xilo-oligosacharides. Enzyme activity will decrease with increasing chain of xilo-oligosacharides (Reilly, 1991; Dekker, 1983). Natuzyme will work efficiently to hydrolyze a very complex chemical compounds from non-starch polysaccharides, by loosening the binding of nutrients to the non-starch polysaccharide matrix, therefore, the nutrients that are bound to non-starch polysaccharides in the matrix was released to facilitate the works of endogenous enzymes.

Materials and Methods

The materials used were 71 native chickens of the age of 18 weeks. Battery cages are used, with the size of 30 x 30 x 30 cm for each unit, equipped with a drinking water from plastic, and feeders made of bamboo. The composition of rations was epidermis of soybean as a source of non-starch polysaccharide, corn, fish meal, soybean meal, salt, $CaCO_3$, premix, coconut oil, methionine, and lysine. Chemicals used for proximate analysis included NaOH, H_2SO_4, HCl, Whatman 41 filter paper, boric acid, indicators, and distilled water. The composition of rations were presented in Table 1. Variables observed included: energy consumption (cal), the consumption of fat (g), glycogen content of meat (%), fat content of meat (%) and meat cholesterol (mg/g).

The experiment was conducted using Completely Randomized Design (CRD) 3 x 3 factorial pattern, each treatment was repeated 3 times. Data analysis was performed using analysis of variance (Steel et al., 1997).

Results and Discussion

The results of the study were presented in Table 2, that energy consumption ranged from 121.32 to 170.22 kilocal. Fat consumption ranged from 3.04 to 4.67 g and the percentage of carcasses ranged from 56.7 to 73.95%. However, the results of analysis of variance of the treatment effect were not significant ($P>0.05$). This was presumably due to the Natuzyme that was still unable to hydrolyze polysaccharides to be a source of energy. Therefore, the treatment did not yet affect the percentage of carcass. The activity of the enzyme is also strongly influenced by the pH of the digestive tract. In the digestive tract, pH tends to be acidic to neutral. Therefore, only the protease and amylase enzymes are active (Walsh, 1979). Natuzyme will work optimally at pH 5 and at 40°C.

The results of Attamangkune (2007) showed that the addition of Natuzyme to feed containing the descending levels of metabolisable energy (ME) did not affect body weight gain, feed intake, and feed efficiency. Bioproton (2007) and Mujeeb (2007) reported that the addition of 250 or 500 ppm of Natuzyme did not affect the consumption of ME and feed conversion.

Protein content of rations was equal so that the carcasses produced were not significantly different. According to Thamrin (1984) and Lubis (1992) the protein content of the ration affects the percentage of chicken carcasses, and chicken carcasses were also influenced by breeds, sex, physical condition and age (Moran and Orr, 1971). Supraptini and Martojo (1977) stated that the percentage of native chicken carcasses at age of 12 weeks is 76.95%.

Analysis of variance showed that the treatment did not significantly affect ($P>0.05$) the fat content of meat, but it significantly affected ($P<0.05$) glycogen content of meat. In addition, the use of Natuzyme significantly affected ($P<0.05$) cholesterol in meat.

The results showed that the level of fat meat was elevated but it was not accompanied by the elevated levels of cholesterol and glycogen

Table 1. Composition and nutrient content of the dietary treatment

Ingredients	Diets		
	R0 (NSP 0%)	R1 (NSP 5%)	R2 (NSP 10%)
Corn	54.00	53.00	55.50
Bran	29.00	25.00	17.50
Soybean cake	9.00	9.00	9.00
Fish meal	5.00	5.00	5.00
Oil	1.00	1.00	1.00
Soy bean epidermis	0.00	5.00	10.00
Limestone	0.75	0.75	0.75
Salt	0.20	0.20	0.20
DL-Methionine	0.25	0.25	0.25
lysine	0.50	0.50	0.50
Topmix	0.30	0.30	0.30
	100	100	100
Protein (%)	14.182	14.226	14.226
Energy (kcal/kg)**	2501.775	2501.775	2501.775
Crude fiber (%)	10.397	13.244	13.414
Fat (%)	7.176	7.775	6.1383
Ca (%) **	1.018	1.055	1.035
P Av (%)**	0.538	0.525	0.522
Lysine (%)**	1.010	0.983	0.943
Methionine (%) **	0.527	0.518	0.508

** Calculated based on NRC Table (1994)

Table 2. Energy intake, fat intake, carcass percentage, fat, glycogen and cholesterol contents of experimental chicken meat

Treatment	Energy intake (k.kal) ^{ns}	Fat intake (g) ^{ns}	Carcass (%)	Fat content (%) ^{ns}	Glycogen content (%) *	Cholesterol content(%) *
R_0S_0	137.63	4.36	63.04	3.30	1.08	99.80
R_0S_1	142.53	4.30	65.35	4.10	0.96	124.38
R_0S_2	139.76	3.84	67.93	3.26	1.48	97.25
R_1S_0	121.32	4.37	65.38	3.50	0.63	97.98
R_1S_1	119.67	4.41	56.70	3.91	0.45	113.55
R_1S_2	135.41	4.65	65.27	3.14	0.57	83.90
R_2S_0	136.23	3.04	63.29	3.47	0.75	102.58
R_2S_1	122.71	3.83	67.39	3.91	0.81	90.70
R_2S_2	170.22	4.67	73.95	2.36	0.73	107.90

R_0S_0 = Feed + 0% NSP + 0% 0% Natuzyme; R_0S_1 = Feed + 0% NSP + 0.1% Natuzyme; R_0S_2 = Feed + 0% NSP + 0.2% Natuzyme; R_1S_0 = Feed + 5% NSP + 0% Natuzyme; R_1S_1 = Feed + 5% NSP + 0.1% Natuzyme; R_1S_2 = Feed + 5% NSP + 0.2% Natuzyme; R_2S_0= Feed + 10% NSP + 0% Natuzyme; R_2S_1 = Feed + 10% NSP + 0.1% Natuzyme; R_2S_2 = Feed + 10% NSP + 0.2% Natuzyme.

content of meat. This is because the use of non starch polysaccharides and Natuzyme did not affect meat fat content. The fat content of meat is influenced by the breeds, age, sex, quality and quantity of feed (Winarno, 1989).

Linder (2006) stated that the breakdown dietary fats into fatty acids, monoglycerides, choline exclusively occurs in duodenum and jejunum. The breakdown of fat occurs with the cooperation between bile salts and pancreatic

lipase in a higher pH environment caused by the secretion of bicarbonate. Fatty acids are stored in the form of triglycerides in fat tissue and muscles.

Energy storage is found in the fat depot, including muscle which is called intramuscular fat. Intramuscular fat in the connective tissue is located in between the bond perimiseal muscle fibers (Suparno, 1992). Hartoyo et al. (2005) reported that the fat content of normal chicken meat was 8.41%.

Chicken meat contains 18.2% protein and 25% total fat. Priambono (2010) reported that the percentage of fat meat ranged from 5.67 to 8.83%, whereas Nurhayati (2009) reported that the percentage of fat meat ranged 7.99 to 8.46%. The results of this study was higher than that reported by Ponte (2004) that the average fat percentage of meat ranges from 1.74 to 2.84% in broiler chickens fed alfalfa. Holy (1995) reported that the average fat content ranges from 2.99 to 3.35%.

Zerehdaran et al. (2004) stated that the composition of feed and feed consumed have a profound influence in the formation of fat in the body of cattle. Montgomery (1996) stated that the function of fat in the body is as a structural component of cell membranes, as an energy storage, as a metabolic fuel and as emulsifiers.

The use of feed sources of non-starch polysaccharides significantly affected ($P < 0.05$) glycogen content of meat. This means that the carbohydrate in chicken meat is widely available in the form of glycogen and lactic acid. Glycogen levels of chicken meat are less than 1 percent, while lactic acid is the main result of the process of glycolysis of glycogen in post-mortem phase and when dying (Forrest et al., 2011).

Riis (1983) stated that the energy stored as glycogen in muscle and liver is limited. Montgomery (1996) stated that glycerol and triglycerides derived from glucose is channeled into adipocytes via the blood. Transport of glucose into cells is facilitated by insulin. Some fatty acids are incorporated in triglycerides synthesized from glucose in adipocytes. The rest comes from the blood in the form of triglycerides contained in chylomicrons or VLDL. Fiber is a component of plants that is resistant to enzymatic digestion (Sarikhan, 2009). Meanwhile, Frigard et al. (1994) reported that fibers have a negative effect on digestion because it could inhibit the absorption of nutrients in the ileum. During the fermentation process, fibers are degraded by microbes into simpler compounds. However, not all fibers are degraded into simpler compounds.

Animals will store fat if the provision of feed energy exceeds the energy required. Wirahadikusumah (1985) stated that biosynthesis (formation) fatty acids are parts of the in the metabolic process at synthesis. Animal tissues have limited capacity to store energy in the form of carbohydrates. Polysaccharide is broken down through the process of glycolysis into acetyl-coenzyme A. which is prerequisite for the biosynthesis of fatty acids and triacylglicerol. Lipid compound has higher energy content than carbohydrates and can be stored as a large energy reserves in fat tissue.

Natuzyme significantly influenced ($P<0.05$) the level of cholesterol in meat. Cholesterol is fat, but they are different in the site of storage. Fat is stored in adipose cells and between muscle cells (outside the muscle cells), whereas cholesterol is stored in the cytoplasm (in muscles).

According to Page (1989) the maximum absorption of cholesterol occurs in the mid part of small intestine and in the end of the ileum where the micelle contains an optimum of fatty acids and monoglycerides. After absorption into the mucosal cells, cholesterol is reconstituted together with triglycerides, phospholipids, apoprotein to form chylomicrons and together with the Very Low Density Lipoprotein (VLDL) to be absorbed into the lymph nodes

approximately 80-90%. Cholesterol biosynthesis mainly occurs in the liver, 33% comes from food and 67% are synthesized in the body (Rettersol et al., 1998). The biggest part of cholesterol is synthesized in the body, approximately 1 g per day, whereas approximately 0.3 g per day derived from feed (Linder, 1992).

Hariadi (2010) stated that the content of saturated fats in palm oil that has not undergone filtering is around 50 percent. Higher oil content in the diets may increase cholesterol content of meat. Sompie (2002) showed that the use of oils that have undergone oxidation can increase the cholesterol content of broiler chicken meat. Other studies conducted by Karamouz (2009) showed that the addition of residual oil mills have a significant effect on elevated levels of cholesterol in meat which is probably due to the high content of trans-fatty acids in the remaining oil factory.

Wirahadikusumah (1985) stated that cholesterol from diets some are transported to the membrane used in the formation of cell membrane structure. Some others are used as precursors for the biosynthesis of steroid hormones, bile acids, sterols and other compounds that are stored in the cytoplasm. Ponte et al. (2004) stated that the factor that affect the cholesterol content is the energy consumption. Cholesterol levels of broiler chicken fed diets containing rice bran oil range 32.27 mg/100 g to 86.79 mg/100 g (Anitha et al., 2007). The results of another study conducted by Ponte et al. (2004) showed that the average cholesterol meat of broiler chickens fed diets containing alfalfa range 39 mg/100 g to 47 mg/100 g. In addition Tangtaweewipat (2000) reported that the average cholesterol meat ranged 42.4 mg/100 g to 82.6 mg/100 g in broiler chickens fed organic mineral and saturated fatty acids. Hartono (1996) suggest that in normal circumstances the liver is capable of producing 500 mg/day of cholesterol.

Linder (2006) further explained that there was no feed-back mechanism of cholesterol biosynthesis in the liver. However, there is restricted enzyme for the biosynthesis of cholesterol, hydroxymetilglutariat CoA reductase (HMG-CoA reductase) is directly inhibited by dietary cholesterol intake. This is consistent with the statement Muchadi et al. (1993) if cholesterol from food is limited to meet the needs of other tissues and organs. The synthesis of cholesterol in the liver and intestine will increase. On the contrary, if the amount of cholesterol in the diet increases the synthesis of cholesterol in the liver and intestine will decrease.

Conclusion

Natuzyme only works on the feed material but it does not work in the chicken digestive tract. Non-starch polysaccharides in the feed can be used as an energy source up to 10% in the chicken ration.

References

Anderson JW. 1985. Physiological and Metabolic Effect of Dietary Fiber. Medical Service. Veterans Administration Medical Center and University of Kentucky Lexington. 44: 2902

Anitha B, M Moorthy and K Viswanathan. 2007. Muscle cholesterol and serum biochemical changes in broilers fed with crude rice bran oil. J. Poult. Sci. 6(12):855-857.

Annison G. 1993. The role of wheat non-starch polysaccarides in broiler nutrition. Austral. J. Agric. Res. 44:405-422.

AOAC. 1990. Official methods of analysis association of official agricultural chemists. Agricultural chemical; Contaminants; Drugs. Vol 2. Association of Official Agricultural Chemist. Inc. Virginia-USA.

Attamangkune S, A Plaiboon, S Sanguanphun and O Trivuttanon. 2007. Effect of Feeding Natuzyme on Broiler Performance. Poultry Research and Development Center and Department of Animal Science. Kasetsart University. Kamphaengsaen Nakhon Pathom. Thailand.

Bioproton Ltd. 2007. Trial Results In Field Scale On Poultry and Quality Control In Production. QC Department Bioproton Pty Ltd. 13/05/04

Brisbane. Australia. www.uq.edu.au/bioproton. (accesed: Dec 10, 2010)

Buckle KA, RA Edward, GH Fleet and M Wooton. 1987. Ilmu Pangan. Universitas Indonesia Press. Jakarta.

Dekker RFH. 1983**.** Bioconversion of hemicellulose: Aspect of hemicellulose production by *Trichoderma reesei* QM 9414 and enzymic saccharification of hemicellulose. Biotechnol. Bioeng. 25:1127-1146.

Dewan Standarisasi Nasional. 1995. Karkas Ayam Pedaging. SNI 01-3924-1995. Dewan Standarisasi Nasional. Jakarta.

Forrest JC, ED Aberle, HB Hendrick, MD Judge and RA Merkel. 2001. Principles of Meat Science. WH Freeman and Company. San Francisco.

Frigard T, D Pettersson and P Aman. 1994. Fiber-Degrading Enzyme Increases Body Weight and Total Serum Cholesterol in Broiler Chickens Fed a Rye-Based Diet. J. Nut. 124(2):2422-2430.

Hariadi P. 2010. Sepuluh Karakter Unggul Minyak Sawit. Info Sawit, Oktober 2010.

Hartono A. 1996. Makanan berserat menurunkan kolesterol. Intisari No392. Maret 1996:38-42

Hartoyo B, I Irawan and N Iriyanti. 2005. Pengaruh asam lemak dan kadar serat yang berbeda dalam ransum ayam broiler terhadap kandungan kolesterol, HDL, dan LDL serum arah. J. Anim. Prod. 7(1):5-10.

Karamouz H. 2009. effect of residual oil of food manufactories on cholesterol and malondialdehyede (mda) in muscles of male broiler. J. Anim. and Vet. Adv. 8(10):2045-2048.

Lawrie RA. 1998. Meat Science. 6th Ed. Wood Head Publishing Ltd. Cambridge.

Linder MC. 2006. Biokimia Nutrisi dan Metabolisme dengan Pemakaian Secara Klinis. UI Press. Jakarta.

Lubis AH. 1992. Respon Ayam Broiler terhadap Penurunan Tingkat Protein dalam Ransum berdasarkan Efisiensi Penggunaan Protein dan Suplementasi Asam Amino Metionin dan Lisin. Disertasi. Fakultas Peternakan. IPB. Bogor

Montgomery R. 1996. Biochemistry A Case Oriented Approaches. 6th Ed. University of Michigan, USA.

Mujeeb A. 2007. Clinical trial report of a Natuzyme (multienzyme) product in commercial Broilers. Poultry Pathologist Veterinary Biological Research Institute Shantinagar. Hyderabad - 500 028. India.

NRC.1994. Nutrien Requirement of Poultry. The 9thEd. National Academic Press. Washington DC.

Page. D.S. 1989. Prinsip-prinsip Biokimia. Edisikedua. PenterjemahSoendoro. Fak. KedokteranUniversitas Airlangga. Surabaya.

Ponte PIP, I Mendez, M Quaresma, MNM Aguair, JPC Lemos, LMA Ferreira, MAC Soares, CM Alfalfa, JAM Prates and CMGA Fontes. 2004. Cholesterol levels and sensory characteristics of meat from broilersconsuming moderate to high levels of alfalfa. Poult. Sci. 83:810–814.

Priambono NB. 2010. Penggunaan Lumpur Sawit Fermentasi Dalam Pakan Terhadap Persentase Lemak Abdomen dan Lemak Daging Ayam Broiler. Skripsi. Universitas Jenderal Soedirman.

Rainbird AL and AG Low. 1986. Effect of various type of dietary fibre on gastric emptying in growing pigs. Brit. J. Nutr. 55:111-112.

Reilly PJ. 1991**.** Xylanase: Structure and Function. In Hollander. A. (Ed.). Proceeding of A Symposium on Trend in Biotechnology of Fermentation for Fuels and Chemicals.Plenum Press, New York.

Rettersol KT, B Hugen, B Woldseth and BO Christopherson. 1998. A comparative study of the metabolism of n-9, n-6 and n-3 fatty acids in testicular cells from immature rat. Biochim. Biophys. Acta. 1392:59-72.

Riis PM. 1983. Dynamic Biochemistry of Animal Production. Elsevier. Amsterdam-Oxford-New York-Tokyo.

Roediger WE. 1982. Utilization of nutriens by isolated epithelial cell of the rat colon. Gastroenterology. 83:824-429.

Sarikhan M, HA Shahryari, K Nazer-adl, B Gholizadeh and B Behesht. 2009. Effects of insoluble fiber on serum biochemical characteristicsin broiler. International J. Agric. Biol.

Scott ML, MC Nesheim, RJ Young. 1982. Nutrition of the Chicken. ML Scott & Associates. New York

Steel RGD, JH Torrie and DA Dickey. 1997. Principles and Procedures of Statistics, a Biometrical Approach. McGraw-Hill Book Co. Inc. Pub. Ltd. London.

Suprapti SM and H Martojo. 1977. Produktivitas Ayam Kampung dan Persilangan F1 pada Pemeliharaan Kandang. Seminar Ilmu dan Industri Perunggasan I. Cisarua. Bogor. Hal. 1-17

Soeparno. 1992. Ilmu dan Teknologi Daging. UGM Press. Yogyakarta

Sompie. 2002. Pengaruh Pemberian Vitamin E. Mineral Se dan BHT dalam Ransum yang Mengandung Minyak Goreng Bekas Terhadap Malonaldehid-9, Perlemakan, Kolesterol dan Performans Ayam Broiler [disertasi]. Bandung Program Pascasarjana. UNPAD.

Tangtaweewipat S, CI Boonlom and M Thanadeach. 2000. Production of low fat and low cholesterol broiler meat by supplementing organic minerals or polyunsaturated oil. Chiang Mai University. Thailand.

Thamrin A. 1984. Pengaruh Ransum dan Galur Ayam terhadap Pembentukan Lemak Tubuh. Tesis. IPB

Varel VH and WG Pond. 1985. enumeration and activity of cellulolitic bacteria from gestating swine fed various levels of dietary fiber. Appl. Env. Micr. 49:858-862.

Walsh C. 1979. Enzymatic Reaction Mechanisms. WH Freeman and Company.

Winarno FG. 1989. Kimia Pangan dan Gizi. Jakarta. Penerbit PT. Gramedia

Zdzislaw M, IG Partridge, G Mithell and HD Keal. 1986. The effect of oatmeals. added to the basal ration for pregnant and reproductive performance. apparent digestibility. Rate of Passage and Plasma Parameters. J. Sci. Food. Agric. 37:239-256.

Zerehdaran S, ALJ Vereijken, JAM Van Arendonk.. and EH Van der Waaij. 2004. Estimation of genetic parameters for fat deposition and carcass traits in broilers. Poult. Sci. 83:521–525.