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Effect of Liquid Nanocapsule Level on Broiler Performance and Total Cholesterol

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Abstract: This research investigated the effects of liquid turmeric extract nanocapsule levels in drinking water on broiler performance and total cholesterol. Eighty-four Lohmann broilers chicks were randomly divided into 7 treatments with 3 replications, each with 4 broilers. Seven treatments were drinking water (DW) + additive bacitracin 12 mg/1000 ml (P1), DW only (P2), DW + 2% nanocapsule (P3), DW + 4% nanocapsule (P4), DW + 6% nanocapsule (P5), DW + 8% nanocapsule (P6) and DW + 10% nanocapsule (P7). The analyzed variables covered production performances (weight gain, feed consumption, feed conversion ratio and water consumption) and total cholesterol (serum, meat and liver). The data were subject to one-way ANOVA analysis followed by Duncan's test in case of significant effect. The results showed that nanocapsule levels significantly ($p<0.05$) affected on weight gain, feed consumption, total cholesterol of meat and liver. It showed no significant ($p>0.05$) effects on feed conversion, water consumption and total cholesterol of serum. Accordingly, 2% liquid turmeric extract nanocapsule, equal to 1.73 mg/100 ml curcumin, was a compatible feed additive for drinking water of broiler chicken to improve the feed efficiency and total cholesterol of meat and liver without negatively affecting performance.

Key words: Liquid-nanocapsule, turmeric-extract, performance, total-cholesterol, broiler

INTRODUCTION

Meat broiler chicken is one of the animal products vastly consumed because of the relatively cheap price with good nutrient content. To support broilers growth, antibiotics are always used as growth promoter that leave residue in meat (Wiyana *et al*., 1999) with relatively high cholesterol content making it less safe for consumption. Phytobiotics use as animal feed additive has increased globally since the ban on synthetic antibiotic use in Europe in 2006 (Miraghaee *et al*., 2011) one of which is turmeric. The studies showed that turmeric as feed additive may increase the performance of broilers (Samarasinghe *et al*., 2003). In addition, curcumin in turmeric has function as hypolipidemic, hypocholesterolemic, antiviral, antibacterial, antifungal, antiprotozoal, anti-inflammatory, antioxidant and anticancer (Araujo and Leon, 2001). Sundari (2014) reported that curcumin in turmeric extracts given to broiler chickens had 46% digestibility (low bioavailability), while the turmeric extract encapsulated with chitosan and STPP in nanoparticles size improved the digestibility of curcumin to 70.64%. Supplementing 0.4% powdered turmeric extract nanocapsule (extracted by ethanol) in broiler chickens can significantly improve the performance of intestine, digestibility, production performance and carcass quality antibiotic residue-free meat with high protein, fatty acids EPA/DHA and minerals but low abdominal fat, subcutaneous fat and cholesterol.

MATERIALS AND METHODS

Experimental design: The research was subject to one-way CRD (Completely Randomized Design), rationing 84 broilers aged 2-6 weeks into seven treatments each with three repetitions. The seven groups were given additive in drinking water namely : drinking water + bacitracin 12 mg/1000 ml (P1), drinking water only (P2), drinking water + 2% nanocapsule (P3), drinking water + 4% nanocapsule (P4), drinking water + 6% nanocapsule (P5), drinking water + 8% nanocapsule (P6) and drinking water + 10% nanocapsule (P7). Feed and drinking water were given *ad-libitum* during four weeks (2-6 weeks).

Procedure: In this study, 400 g of turmeric was blended in 500 mL of aquadest (equivalent to 5 g turmeric extract with ethanol). Five g Chitosan was dissolved in 400 mL of 2.5% citric acid concentrate and mixed with a blender for 20 minutes, then the 2.5 g STPP was dissolved in 100 mL aquadest and mixed with blender for 20 min. The outcome was in the form of liquid turmeric extract nanocapsule with a diameter of 50 nm (Fig. 1). Nanocapsule was supplied to the drinking water of experimental animals in each treatment level during week 2-6. Broilers were fed with commercial diet BR1 from Japfa Comfeed® from the age of 0 to 2 week, then fed with basal rations afterwards as presented in Table 1.

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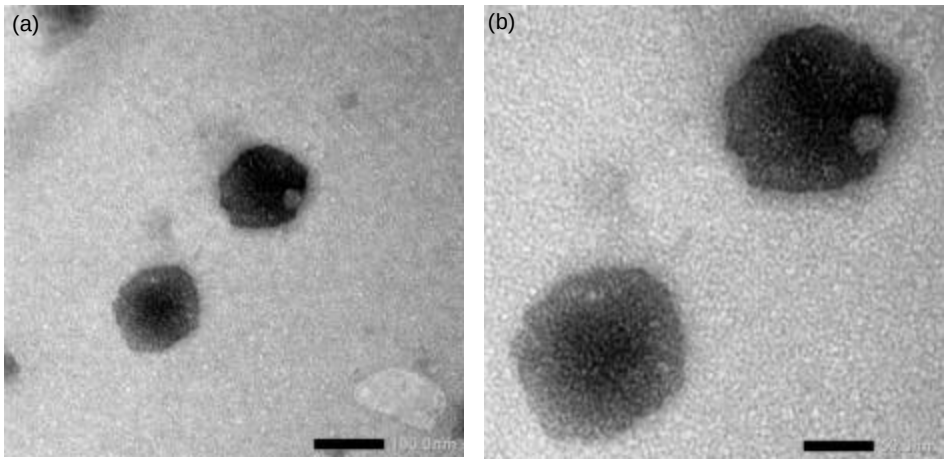

Fig. 1: Transmission electron micrographs of liquid turmeric extract nanocapsule: A (scale 100 nm) B (scale 50 nm)

Parameter measured: The variables included body weight gain, feed consumption, feed conversion ratio (FCR) and water consumption (Fadilah, 2005) and total cholesterol (TC) was measured using CHOD-PAP method (Supadmo, 1997) to test TC of serum, meat and liver.

Data analysis: The data obtained were subject to analysis of Variance (ANOVA), followed by Duncan's test in case of significant effect using SPSS-16.

RESULTS AND DISCUSSION

Production performance: Table 2 shows that drinking water added with 2% nanocapsule (P3) resulted in the best FCR (no significant difference, $p>0.05$), nanocapsule $\geq$2% reduced FCR but increased feed and water consumption, body weight gain (significant difference, $p<0.05$). The use of liquid turmeric extract nanocapsule was optimum at 2% and maximum at 8% on drinking water. Nanocapsule >8% will become poisonous followed by the significant decrease of all parameters (Table 2). Bintang and Nataamijaya (2005) reported that turmeric can reduce feed intake of broiler. Decline in feed consumption was likely due to turmeric content, a volatile oil with typical odor, spicy and bitter taste thereby reducing palatability (Sambaiah *et al*., 1982; Widhyari and Wientarsih, 2014). The increasing body weight gain on nanocapsule treatments are influenced by curcumin as active substance in turmeric with anti-bacterial activity that can inhibit pathogenic bacteria growth, especially in the gastrointestinal tract which ultimately improves the growth (Susilawati *et al*., 1985; Widjaja *et al*., 2006). Data in Table 2 indicate that feed conversion ratio in this study ranges from 1.76 to 1.89. Amrullah (2004) and Mide (2013) reported that the broiler feed conversion ranged from 1.75 to 2.00. The treatments of liquid turmeric extract nanocapsule increased feed intake also water consumption. The water consumption is directly related to feed intake (Marks, 1985; Houpt, 1987; Schoorlemmer and Evered, 2002; Scott, 2005), while other reports attributed it to feed composition (Belay and Teeter, 1993) and water quality (Barton, 1996; Grizzle *et al*., 1997).

Table 1: Composition of basal ration (BR)[1]

Ingredients	Starter (0-2 weeks) (%)	Grower (2-6 weeks) (%)
Yellow corn	52.00	52.00
Rice brand	10.00	12.50
Soy bean meal 45	21.00	19.50
Fish meal 55	12.00	9.50
Crude palm oil	3.70	5.10
Limestone	0.13	0.30
Salt NaCl	0.08	0.20
Masamix [2]	0.44	0.10
L-Lysine HCl	0.35	0.40
DL methionine	0.30	0.40
Total	100.00	100.00
Nutrient composition		
Crude protein (%)	22.13	20.21
ME (kcal/kg)	3143.99	3201.77
Extract ether (%)	5.30	5.41
Crude fiber (%)	3.14	3.35
Calcium (%)	0.92	0.90
Phosphor available (%)	0.50	0.43
L-Lysin HCl (%)[3]	1.51	1.41
DL-Methionine (%)[3]	1.41	1.35

Description: [1]Nutrient requirement of broilers (NRC, 1994)
[2]Composition of masamix per kilogram : vit A 810000 IU, D3 212000 ICU, E 1.8 g, K3 0.18 g, B1 0.112 g, B2 0.288 g, B6 0.3 g, B12 0.0036 g, Co 0.028 g, Cu 0.5 g, Fe 6.0 g; Mn 6 g; Iod 0.1 g; Zn 5 g, Se 0.025 g, DL-Met 212.5 g, L-Lys 31 g, Foleic ac. 0.11 g, Panthotenic ac. 0.54 g. Niacin (vit B3) 2.16 g, Cholin Cl60% 75 g
[3]Higher of NRC (1994) but non excess of Lys (<3%) and Met (<2%) (Acar *et al*., 2001)

Total cholesterol (serum, meat and liver): Research on bacitracin (P1) addition resulted in non-significantly lowest percentage of total cholesterol of serum ($p<0.05$)compared to other treatments. Two percent nanocapsule intake resulted in the lowest total cholesterol in all parameters compared to the other nanocapsule treatments. Total cholesterol levels of serum are within the range of 146-177 mg/dl. This was

Table 2: Effect of additional liquid turmeric extract nanocapsule in ration on productions performance: feed consumption, weight gain, feed conversion ratio and water consumption of broiler chicken

Treatments	Feed consumption (g) Average*±SEM	Weight gain (g) average*±SEM	Feed conversion ratio average^{ns}±SEM	Water consumption (g) average^{ns}±SEM
P1	3607.75±164.32^{cde}	634.37±7.26^{b}	1.89±0.07	9531.08±478.37
P2	3155.75±104.18^{a}	578.33±10.46^{a}	1.82±0.03	9448.50±846.84
P3	3393.08±144.52^{abc}	644.26±13.57^{b}	1.76±0.11	9105.67±644.59
P4	3464.92±125.15^{bcd}	645.67±25.63^{b}	1.80±0.01	9814.42±582.09
P5	3664.08±35.69^{de}	650.53±5.39^{b}	1.88±0.003	9962.08±580.88
P6	3723.75±189.32^{e}	669.45±7.90^{b}	1.85±0.07	10057.08±561.05
P7	3285.58±113.87^{ab}	597.70±36.58^{a}	1.84±0.17	9534.25±973.36

Description: *Values bearing different superscripts indicate significant difference (p<0.05). ^{ns}Superscripts indicate non-significant differences (p>0.05).
P1 (drinking water+Bacitracin 12 mg) P4 (drinking water+4% nanocapsule) P7 (drinking water+10% nanocapsule)
P2 (drinking water only) P5 (drinking water+6% nanocapsule)
P3 (drinking water+2% nanocapsule) P6 (drinking water+8% nanocapsule)

Table 3: Effect of additional liquid turmeric extract nanocapsule in drinking water on total cholesterol content of serum, meat and liver of broiler chicken (mg/dl)

Treatments	TC serum average^{ns}±SEM	TC meat average*±SEM	TC liver Average*±SEM
P1	146.08±32.94	13.16±4.03^{a}	72.68±12.63^{ab}
P2	146.08±19.12	31.55±9.57^{b}	147.45±42.47^{c}
P3	160.80±35.61	5.52±3.18^{a}	35.65±12.60^{a}
P4	162.75±22.83	8.50±5.16^{a}	84.26±42.82^{ab}
P5	172.55±23.43	5.57±3.15^{a}	59.26±40.17^{ab}
P6	173.53±24.61	7.93±3.94^{a}	71.53±37.57^{ab}
P7	177.45±21.18	13.15±9.87^{a}	98.84±57.37^{b}

Description: *Values bearing different superscripts indicate significant difference (p<0.05).
^{ns}Superscripts indicate non-significant differences (p>0.05)
P1 (drinking water+Bacitracin 12 mg)
P2 (drinking water only)
P3 (drinking water+2% nanocapsule)
P4 (drinking water+4% nanocapsule)
P5 (drinking water+6% nanocapsule)
P6 (drinking water+8% nanocapsule)
P7 (drinking water+10% nanocapsule)

in accordance with 125-200 mg/dl range by Mangisah (2003). Widjaja *et al.* (2006) stated that the content of cholesterol in the serum by 5% comes from the cholesterol contained in the feed material and 80% is derived from cholesterol synthesis by the liver. The high and low cholesterol in the body is therefore affected by the speed of cholesterol synthesis in body. Mangisah (2003) and Sinurat *et al.* (2009) stated that the decrease in serum cholesterol level in broilers was due to the content of bioactive substances, curcumin and essential oils in the herbs that increased the production and secretion of bile through feces. Consequently, cholesterol level in blood and body would drop.

Total cholesterol of meat in this research was excellent, ranging from 5-31 mg/100 g or below the normal range from previous research. Al-Najdawi and Abdullah (2002) reported that total cholesterol of broiler meat without skin was 133-202 mg/100 g dry matter, while intact meat was 261-407 mg/100 g dry matter. Rusmana *et al.* (2008) stated that broiler meat cholesterol level was between 79.63-80.47 mg/100 g.

The research data in Table 3 demonstrate that nanocapsule treatment have lower total cholesterol levels of liver than control. This was likely due to the active substance content of turmeric. Sunaryo *et al.* (1992) and Widjaja *et al.* (2006) stated that curcumin in turmeric could decrease cholesterol level in rat liver. Wahyono (2002) reported that bile acids emission in the intestine increased in stimulating the liver to synthesize cholesterol and the result was distributed throughout the digestion organs so that cholesterol in the blood decreased and was used for mobilization of liver fat synthesis.

Conclusion: The liquid turmeric extract nanocapsule was a viable feed additive for drinking water of broiler chicken at level 2% (equal to 1.73 mg/100 mL curcumin used). It could improve the FCR and reduce all total cholesterol parameters without negatively affecting the performance.

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REFERENCES

Acar, N., P.H. Patterson and G.F. Barbato, 2001. 1. Appetite suppressant activity of supplemental dietary amino acids and subsequent compensatory growth of broilers. J. Poult. Sci., 80: 1215-1222.

Al-Najdawi, R. and B. Abdullah, 2002. Proximate composition, selected minerals, cholesterol content and lipid oxidation of mechanically and handdeboned chicken from the jordanian market. J. Meat Sci., 61: 243-247.

Amrullah, I.K., 2004. Nutrisi Ayam Broiler. Cetakan ke-3. Lembaga Satu Gunung Budi. Bogor.

Araujo, C.C. and L.L. Leon, 2001. Biological activities of *Curcuma longa* L. Mem Inst Oswaldo Cruz., 96: 723-728.

Barton, T.L., 1996. Relevance of water quality to broiler and turkey performance. J. Poult. Sci., 75: 854-856.

Belay, T. and R.G. Teeter, 1993. Broiler water balance and thermobalance during thermoneutral and high ambient temperature exposure. J. Poult. Sci., 72: 116-124.

Bintang, I.A.K. and A.G. Nataamijaya, 2005. Pengaruh penambahan tepung kunyit (*Curcuma domestica* Val) dalam ransum broiler. Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner, Bogor. 12-13 September 2005. Puslitbang Peternakan, Bogor, 733-736.

Fadilah. R., 2005. Panduan Mengelola Peternakan Ayam Broiler Komersial. PT. Agromedia Pustaka. Jakarta.

Grizzle, J.M., T.A. Armbrust, M.A. Brya and A.M. Saxton, 1997. Water quality II: the effect of water nitrate and bacteria on broiler growth performance. J. App. Poult. Res., 6: 48-55.

Houpt, T.R., 1987. Influences of water on feed intake. In: Proceedings of the 8th western nutrition conference. Edmonton. Alberta, 63-65.

Mangisah, I., 2003. Pemanfaatan kunyit (*Curcuma domestica* Val) dan temulawak (*Curcuma xanthorrhiza* Roxb) sebagai upaya menurunkan kadar kolesterol daging ayam broiler. Jurnal Litbang Propinsi Jawa Tengah. Badan Penelitian dan Pengembangan Propinsi Jawa Tengah. Semarang.

Marks, H.L., 1985. Sexual dimorphism in early feed and water intake of broilers. J. Poult. Sci., 64: 425-428.

Mide, M.Z., 2013. Ransum mengandung tepung daun katuk, rimpang kunyit dan kombinasinya. J. Teknosains, 7: 40-46.

Miraghaee, S.S., H. Behzad, A. Hossein, S. Akbar, E. Mazda and N.M.H. Modaber, 2011. The effects of *Nigella sativa* powder (black seed) and *Echinacea purpurea* (L.) moench extract on performance, some blood biochemical and hematological parameters in broiler chickens. Afri. J. Biotech., 10: 19249-19254.

NRC, (National Research Council), 1994. Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press. USA. Washington DC.

Rusmana, D., W.G. Piliang, A. Setiyono and S. Budijanto, 2008. Pengaruh pemberian ransum mengandung minyak ikan lemuru dan vitamin E terhadap kadar lemak dan kolesterol daging ayam broiler. J. Anim. Prod., 10: 110-116.

Samarasinghe, K., C. Wenk, K.F.S.T. Silva and J.M.D.M. Gunasekera, 2003. Turmeric (*Curcuma longa*) root powder and mannan-oligosaccharides as alternatives to antibiotics in broiler chicken diet. Asian-Aust. J. Anim. Sci., 16: 1495-1500.

Sambaiah, K.S., K.S. Ratankumr, U.S. Kamnna, M.N. Satyanarayana and M.V.L. Rao, 1982. Influence constituents and curcuma on growth, blood, constituents and serum enzymes in rat. J. Food Sci. and Tech., 19: 187.

Schoorlemmer, G.H.M. and M.D. Evered, 2002. Reduced feeding during water deprivation depends on hydration of the gut. Regulatory, integrative and comparative physiology. Am. J. Phys., 283: 61-69.

Scott, T.A., 2005. The impact of pelleting and enzyme supplementation on feed value of twenty-five Canadian wheat samples. Aust. Poult. Sci. Symposium, 17: 138-44.

Sinurat, A.P., T. Purwadaria, I.A.K. Bintang, P.P. Ketaren, N. Bermawie, M. Rahardjo and M. Rizal, 2009. Pemanfatan kunyit dan temulawak sebagai imbuhan pakan untuk ayam broiler. JITV, 14: 90-96.

Sunaryo, H., S.P. Ediyanto, W. Djatmiko and A. Fuad, 1992. Pengaruh pemberian kurkuminoid (*Curcuma domestica val.*) terhadap kadar kolesterol HDL serum tikus putih (*Rattus novergicus*). Pusat Penelitian Obat Tradisional UNAIR. Surabaya.

Sundari, 2014. Nanoenkapsulasi ekstrak kunyit dengan kitosan dan sodium-tripolifosfat sebagai aditif pakan dalam upaya perbaikan kecernaan, kinerja dan kualitas daging ayam broiler. Disertasi. Fakultas Peternakan, Universitas Gadjah Mada. Yogyakarta.

Supadmo, 1997. Pengaruh sumber khitin dan prekursor karnitin serta minyak ikan lemuru terhadap kadar lemak dan kolesterol serta asam lemak omega-3 ayam broiler. Disertasi. Program Pascasarjana, Institut Pertanian Bogor. Bogor.

Susilawati, S. Bambang and D. Wahyu, 1985. Pengaruh daya anti mikroba dari rimpang *Curcuma domestica Val.* terhadap bakteri *Escherichia coli.* Pros. Simposium Nasional Temulawak UNPAD. Bandung, 174-180.

Wahyono, F., 2002. Pengaruh teknologi probiotik terhadap tingkat konsumsi pakan, pertumbuhan bobot badan dan kolesterol darah ayam broiler yang diberi pakan tinggi lemak jenuh atau tak jenuh. J. Pengembangan Peternakan Tropis, 27: 36-43.

Widhyari, S.D. and I. Wientarsih, 2014. Pengimbuhan kunyit dan seng oksida dalam pakan meningkatkan kemampuan ayam pedaging dalam mengeliminasi tantangan infeksi *Escherichia coli.* J. Vet., 15: 337-344.

Widjaja, E., W.G. Piliang, I. Rahayu and B.N. Utomo, 2006. Produk samping kelapa sawit sebagai bahan pakan alternatif di Kalimantan Tengah: Pengaruh pemberian solid terhadap performans ayam broiler. JITV, 11: 1-5.

Wiyana, I.K.A., Nasrudin and J.H.P. Sidadolog, 1999. Pengaruh oksitetrasiklin dan amoksisilin sebagai aditif pakan terhadap performan, residu dalam jaringan dan ekskreta broiler. Buletin Peternakan 23: 166-177.